GAC 803 REV. 2
2-77

GRUMMAN

GRUMMAN AEROSPACE CORPORATION
BETHPAGE, NEW YORK 11714

NSS-SFDS-LR028
Contract NAS8-32472
March 2, 1978

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Attention: Erich E. Engler, COR
Code EP-13 Bldg. 4610

Subject: SPACE FABRICATION DEMONSTRATION SYSTEM - Quarterly Progress Report No. 4 November 16, 1977 - February 15, 1978

Enclosures: (1) Fabrication Facility Design and Construction
(2) SFDS Reduced Quantity Attachment Spotwelds, IOM MP-AMPD-MO-78-15, Marx to Muench, 27 January 1978

References: (a) SFDS - Monthly Progress Letter No. 7, November 16, 1977 - December 15, 1977
(b) SFDS - Monthly Progress Letter No. 8, December 16, 1977 - January 15, 1978

SUMMARY

~~The Space Fabrication Demonstration System (SFDS) program successfully completed its third and final incremental critical design review (ICDR) during this fourth quarter year reporting period. This ICDR held on December 14, 1977 included:~~ reported. The following subsystems were reviewed:

- Cross brace magazine/dispenser subsystem; and
- Rolling mill supply reel, guide and drive.

At the conclusion of the ICDR ~~we received concurrance from NASA-MSFC to~~ permission was granted to proceed with the fabrication of the above subsystem and subsystem components.

During the next monthly reporting period, we anticipate completion of the mechanical/structural assembly of the beam builder. This completion program milestone originally scheduled for the end of February, 1978 has been delayed about ten working days primarily due to lost time resulting from the extreme weather conditions prevailing throughout the northeastern portion of the United States. With the control subsystem debugging already initiated and installation of all electrical and electronic subsystems following completion of the mechanical/structural assembly being expedited, we believe that the remaining subsystem debugging and preparation for first production of beams by the beam builder will bring us back on schedule.

SPACE FABRICATION DEMONSTRATION SYSTEM

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No major problems are anticipated at this time

The weekly telcon review continues to provide an excellent information base for problem resolution as they occur. These and the periodic meetings with NASA-MSFC program personnel have assisted in keeping the program progressing smoothly.

DISCUSSION

WBS 1.1 PROGRAM MANAGEMENT

Continued detailed review of tasks committed versus task completion has kept the SFDS program essentially on schedule. Our progress is shown in percent completion, where applicable, in Figure 1 SFDS Master Program Schedule. Deviations from the schedule and changes made to it are discussed under the appropriate work breakdown structure (WBS) subparagraph below.

WBS 1.2 DESIGN AND DEVELOPMENT

1.2.1 Structural Member Development

No further analysis effort is being conducted in this area at this time. The test of the structural test truss has now been rescheduled for the week of April 3, 1978. The roll formed cap member and cross brace material has been received, will be cut to length and assembly initiated during the next reporting period. The completed test plan is being reviewed at the present time.

1.2.2 Fabrication Facility Design

Detail design of all major subsystem components are being finalized. Detailed discussion of this line item is included in enclosure (1).

To facilitate a simplification of the weld mechanism the number of spot welds per structural joint were reduced from eight to six. Enclosure (2) documents the tests conducted to confirm the acceptability of this change. A side benefit of this change is the doubling of the length of truss which can be produced within known electrode life limits.

WBS 1.3 FABRICATION and ASSEMBLY

1.3.1 Detailed Parts

The difficulties associated with the roll forming tooling reported in references (a) and (b) have been resolved. The first rolling mill has been accepted and delivered to Grumman. It is anticipated that the remaining two will be accepted and delivered shortly.

Detailed parts fabrication at Grumman and various vendors continues. No problems are anticipated which will impede the on-time delivery of components needed to complete the various beam builder subsystems.

Fabrication of detailed parts at Grumman is discussed in enclosure (1).

1.3.2 Assembly

Assembly of the beam builder continues at a steady pace. It is described in enclosure (1). No difficulties in completing the mechanical/structural assembly as currently scheduled are anticipated at this time.

WBS 1.4 TEST

As noted above, the first of the rolling mills has passed acceptance tests and is now at Grumman. The completion of acceptance testing of the remaining two rolling mills is expected to take place shortly.

The roll form tooling for forming cross brace material has also passed acceptance test and has been delivered to Grumman.

No development tests in connection with the beam builder were conducted during this quarterly reporting period.

WBS 1.5 FLIGHT DEMONSTRATION PLAN

Preparation for implementing the review of the preliminary flight demonstration plan, incorporating NASA-MSFC comments to the preliminary plan and detailing the analytical, design, modification and test requirements to produce a final flight demonstration plan with a definitive schedule and cost has been initiated. Effort associated with the plan will be fully implemented during the next reporting period.

CONCLUSION

Problem resolution and subsystem work arounds during this fourth contract quarter have kept the SFDS program moving along satisfactorily.

NSS-SFDS-LR028

RECOMMENDATION

Continued close management surveillance of all SFDS program elements and liaison by NASA-MSFC and Grumman program management personnel.

Should you have any questions or comments with regard to the above, the enclosures or the program in general, please contact us.

Very truly yours,

GRUMMAN AEROSPACE CORPORATION

Walter K. Muench

Walter K. Muench
SFDS Program Manager

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SFDS MASTER PROGRAM SCHEDULE

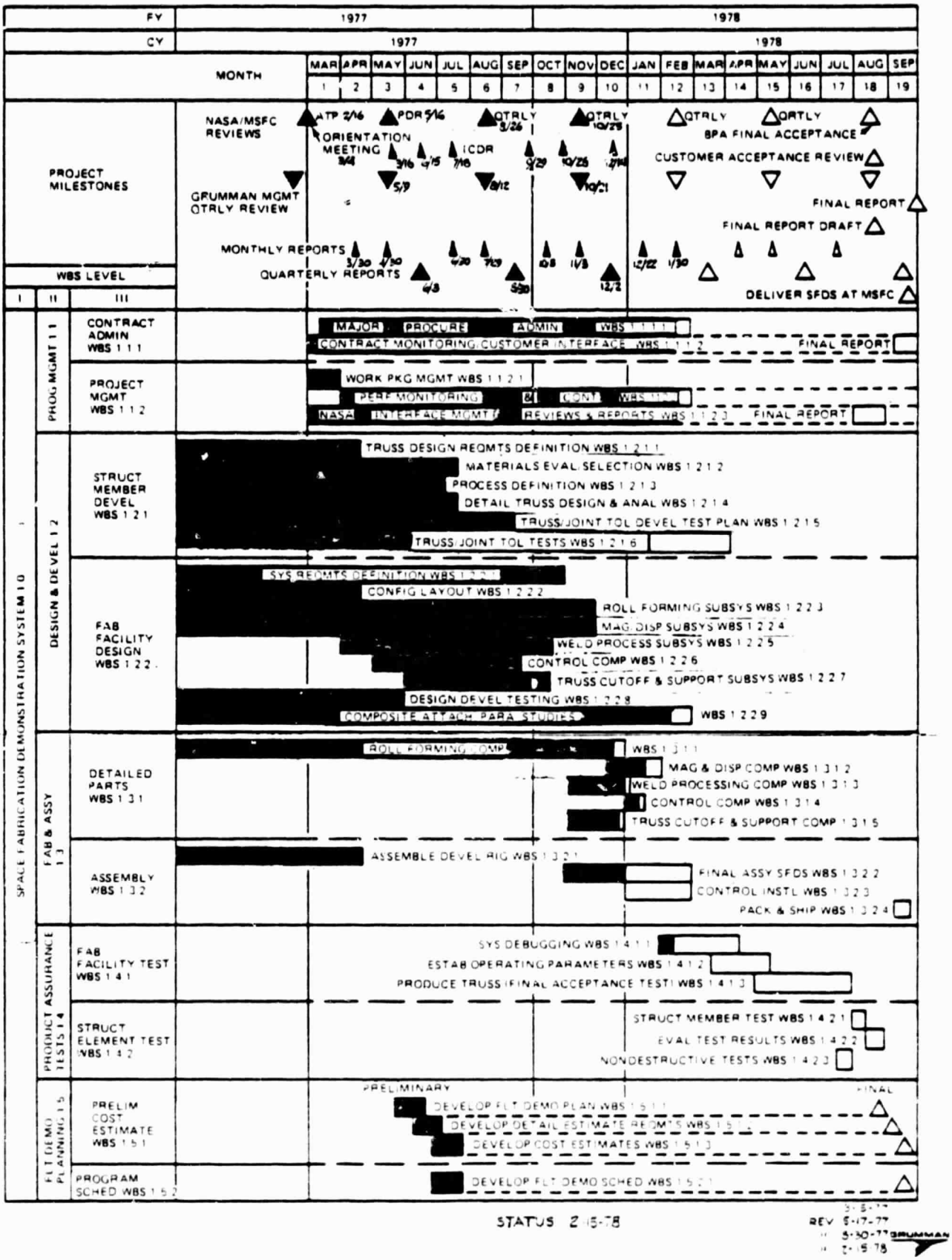


FIGURE 1

ENCLOSURE (1)

FABRICATION FACILITY DESIGN AND CONSTRUCTION

ENCLOSURE 1

WBS 1.2.2 FABRICATION FACILITY DESIGN

The third and final Interim Critical Design Review (ICDR) was held on 12/14/77 at MSFC Huntsville, Alabama and covered the brace storage magazine and dispensing system, and the Yoder roller supply spool and guide system.

Roll Forming

The final drawings for the feed roll and self-threading mechanisms (Figure 1), containing wipers for strip cleanliness and mounting brackets for the TRAV-A-DIAL digital-readout measuring system have been completed. The details have been loaded into the shop, material has been ordered, and purchase orders written.

Welding and Clamp Mechanism

The cable length and buss bar configuration design for the vertical and diagonal weld block assemblies is in process. The final assembly of the weld block assemblies (Figure 2) was a pre-requisite to starting this task, in order to facilitate design and fabrication of the detail parts.

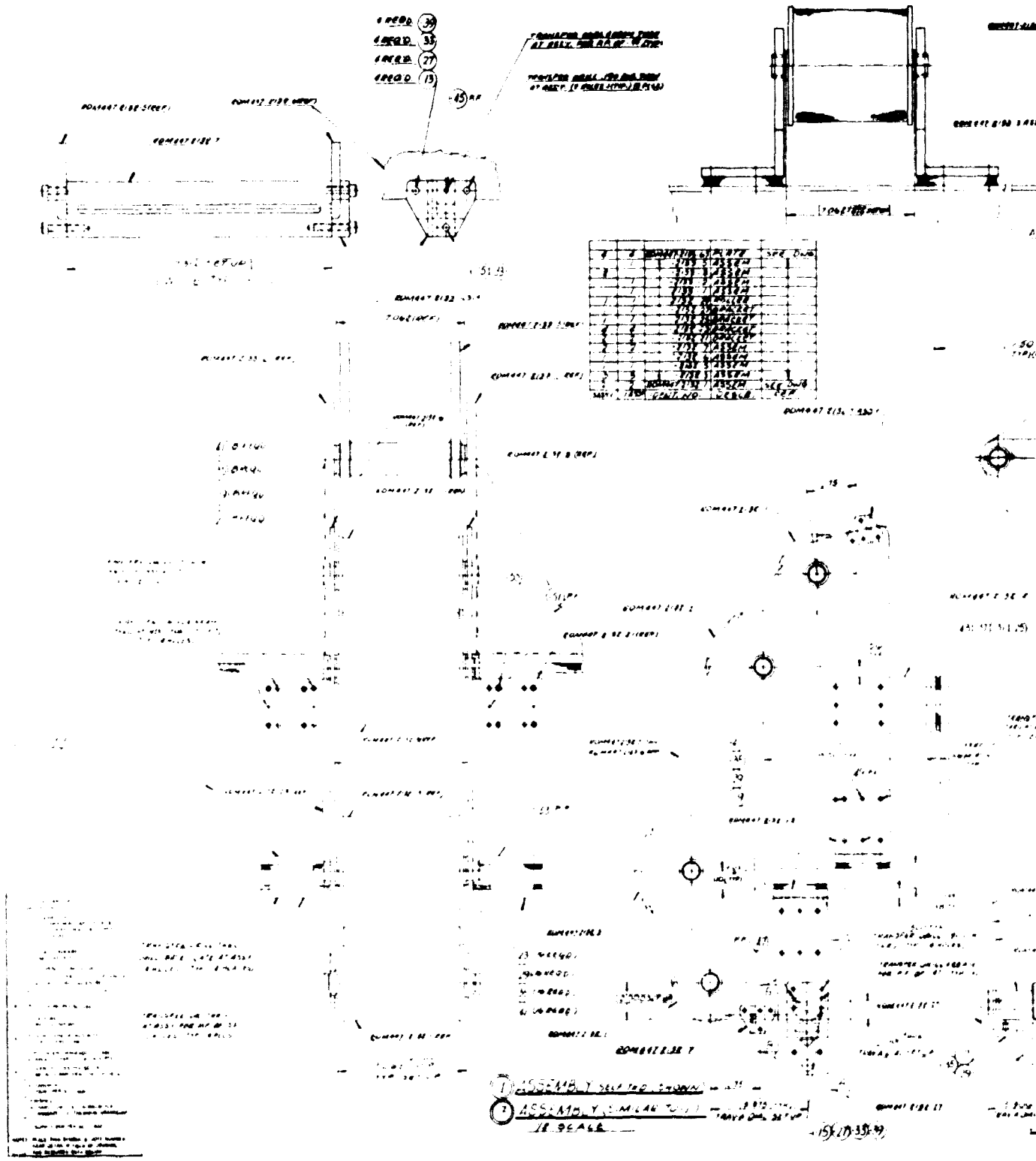
With the completion of these tasks, all of the major component sub-system design efforts have been completed on the S.F.D.S.

All of the finished drawings are in the final stages of completion and the final assembly drawing (ROM447-2200) has been started. All of the detail and sub-assembly drawings related to the fabrication of the S.F.D.S., along with their current change status, are listed in Table I.

1.3.1 DETAIL PARTS FABRICATION

Roll Forming

All detail parts for the S.F.D.S. support structure have been fabricated, primed, and painted and are in the final stages of subassembly. This includes the three bulkheads, the three box beams (Figure 3), the internal truss support structure (Figure 4), the diagonal support bracket, the base frame and all mounting brackets. The raw material spool detail parts have been fabricated, primed,



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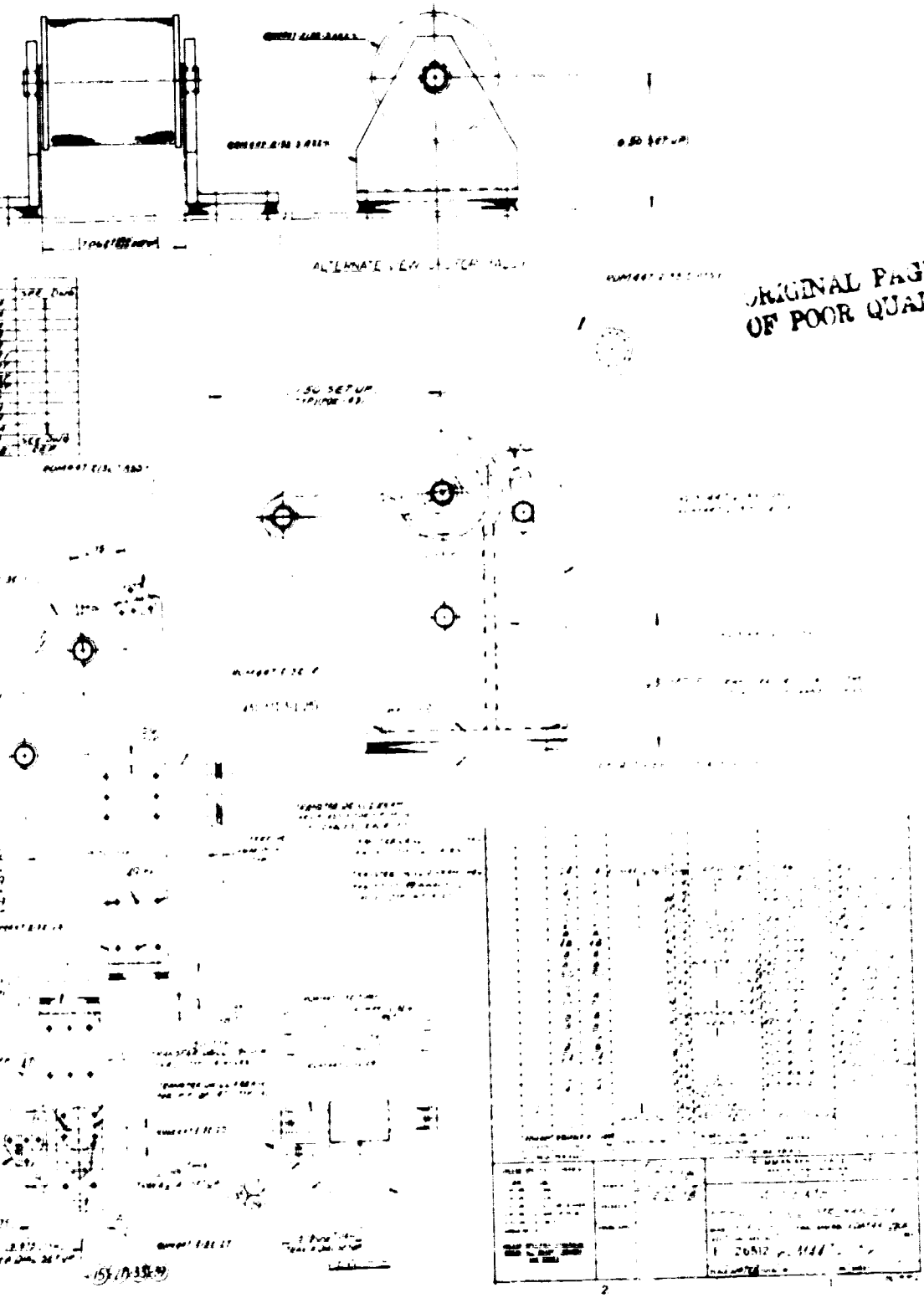


Figure 1

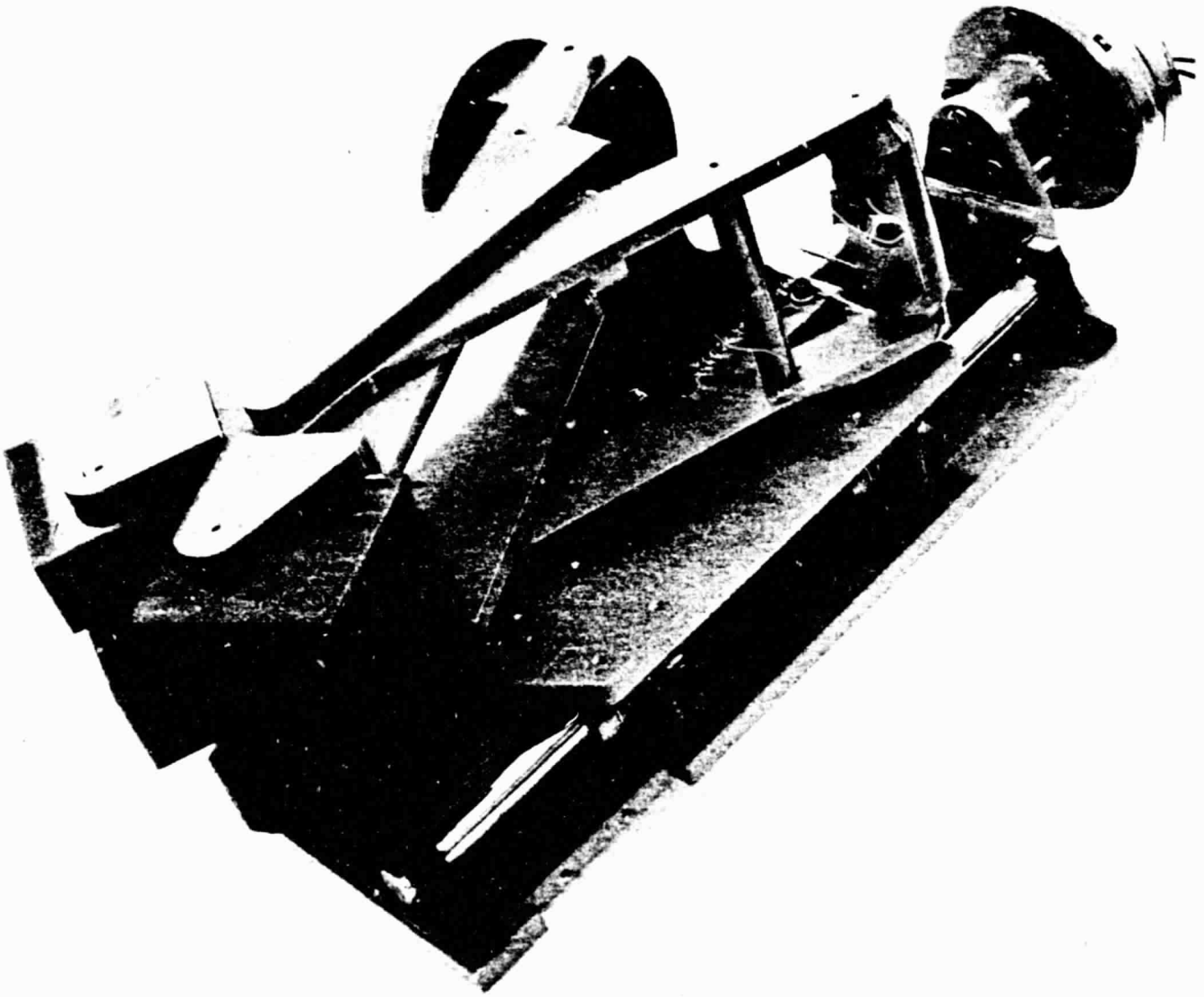


Figure 2 Weld Block Assembly

Figure 3 Box Beam With Yoder Plate

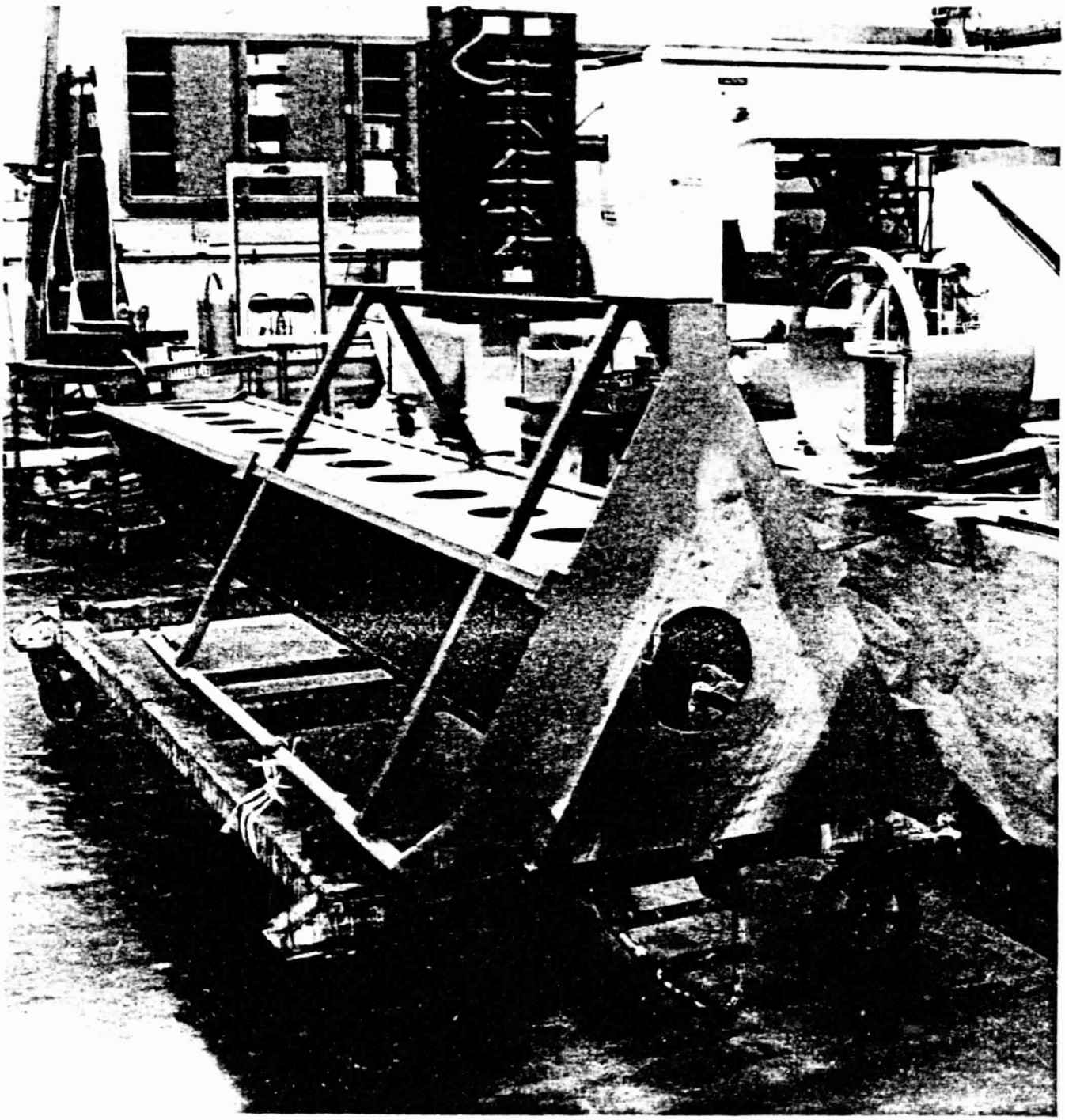


Figure 4 Internal Truss Support

and painted. The feed spool and self-threading mechanism details have been shop loaded and fabrication has started. The Yoder drive detail parts have been completed, primed, and painted. The Yoder rolling mill No. 3 was received from the vendor and was installed on the box beam support structure (Figure 5 and 6).

Welding and Clamp Mechanism

All detail parts for the vertical and diagonal weld block mechanisms have been fabricated, primed, painted and are in the final assembly stage. The transformers have been received at GAC and are ready for installation. The transformer mounting brackets have been fabricated and are ready for installation. The welding control unit has been received from the vendor and has been installed in front of bulkhead No. 1 (Figure 7).

Brace Magazine and Dispensing System

All details for the vertical and diagonal brace magazine and dispensing system are in the process of being fabricated. The final drawing (ROM447-2100) for both the vertical and diagonal magazines is shown in Figure 8. The unit uses mated pairs of helixes (Figure 9) which rotate and translate the braces to the carriage assembly (Figure 10), which in turn transfers the brace member down to the cap interface. The entire magazine unit is designed as a module which can readilly be removed from the machine. A series of hinge points (Figure 11) on each of the magazines will be used to provide easy re-loading directly on the machine. All of the magazine mounting brackets have been fabricated, primed, painted and are ready for installation.

Truss Cut-off Mechanism

All detail parts for the truss cut-off mechanism are in various stages of completion and partial assembly has been started. Figure 12 shows the Upper Movable Die Sub-Assembly which actuates thru the use of a ball screw. The middle die sub-assembly (Figure 13) is near completion. The lower die sub-assembly (Figure 14) actuates thru the use of a ball screw.

Controls

All of the computer integrated wiring (Figure 15) has been completed and is in the process of being de-bugged.

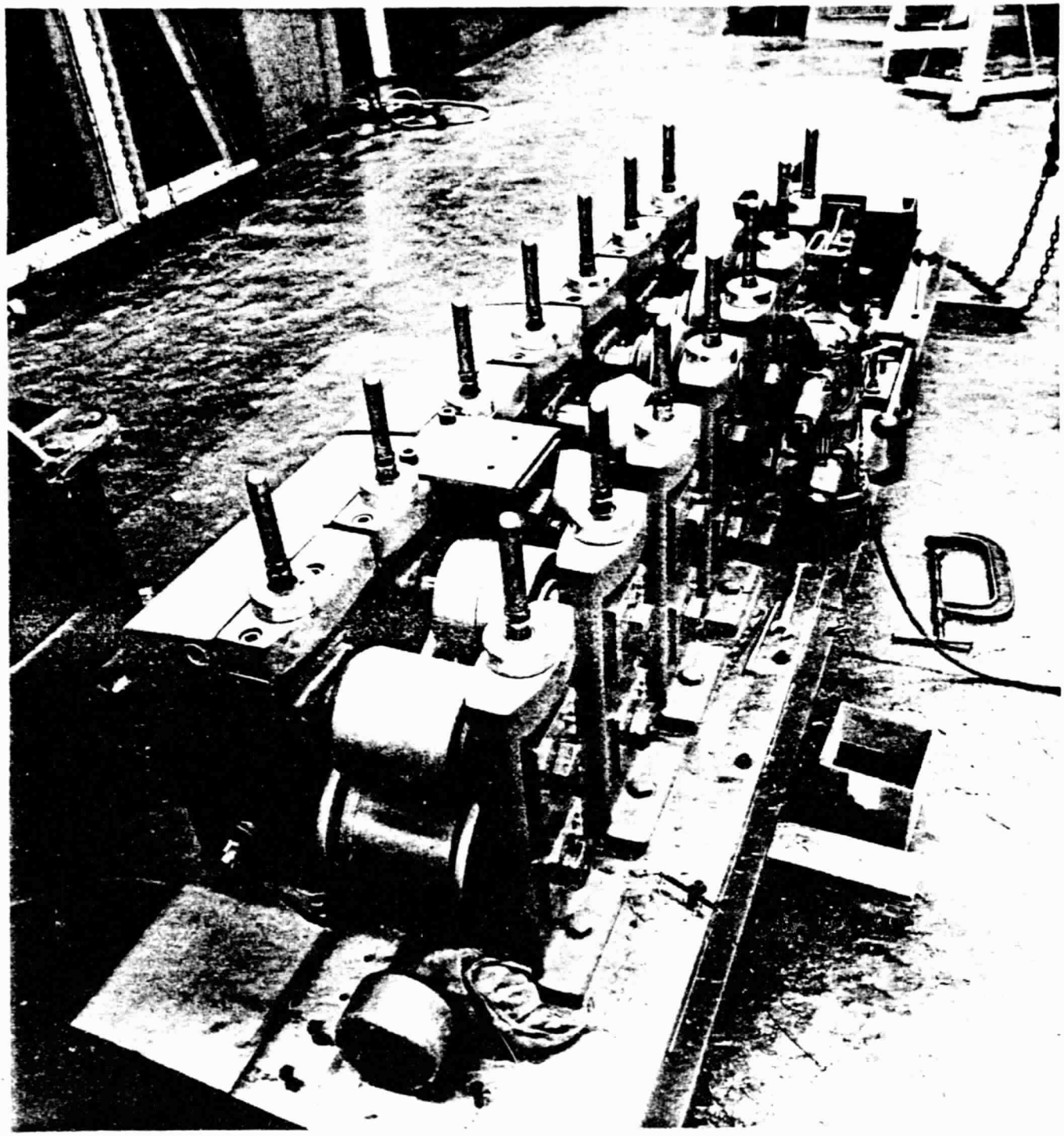


Figure 5 Yoder Mill No. 3 Mounted On Box Beam

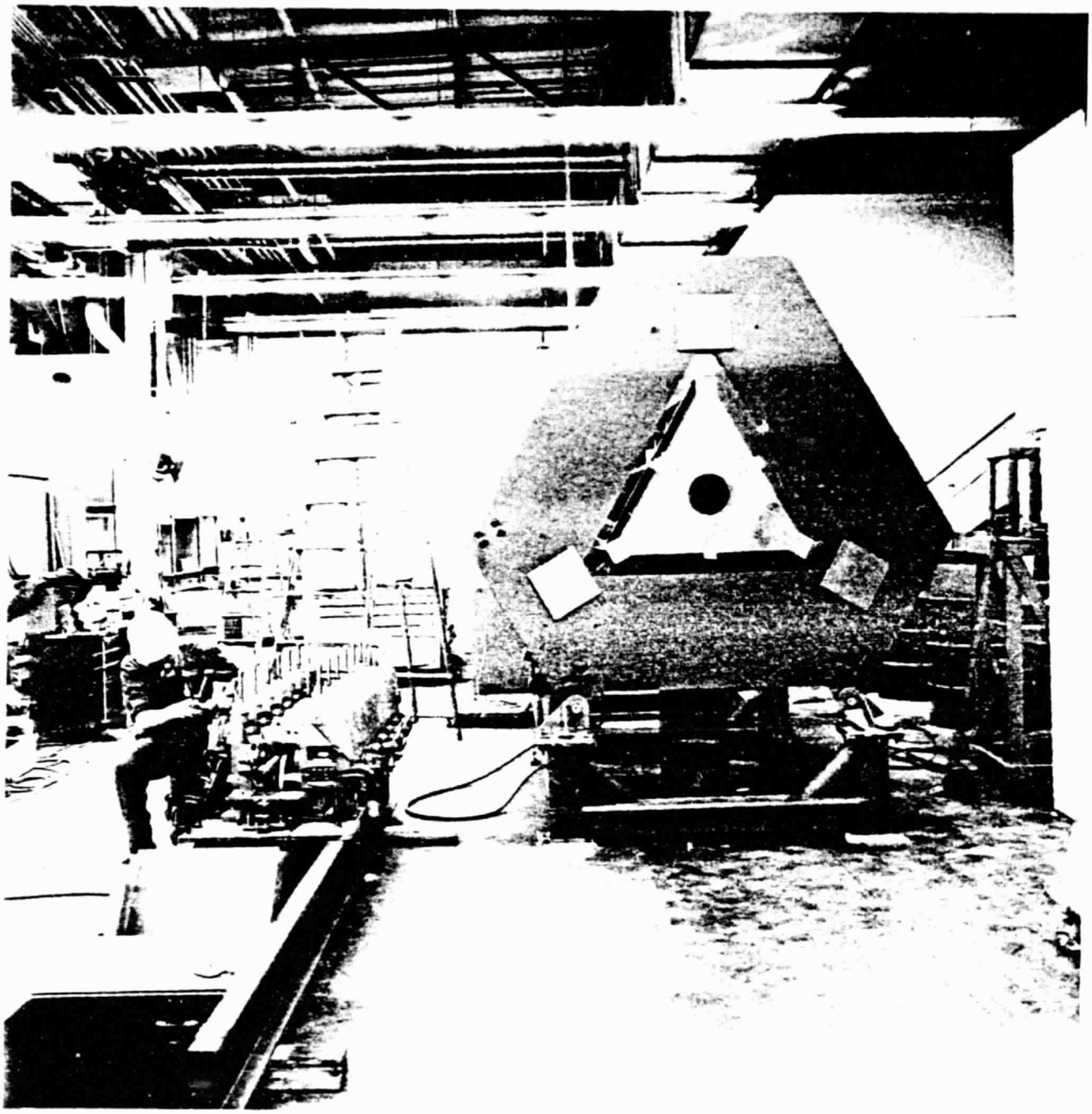


Figure 6 Yoder Mill No. 3 Mounted On Box Beam

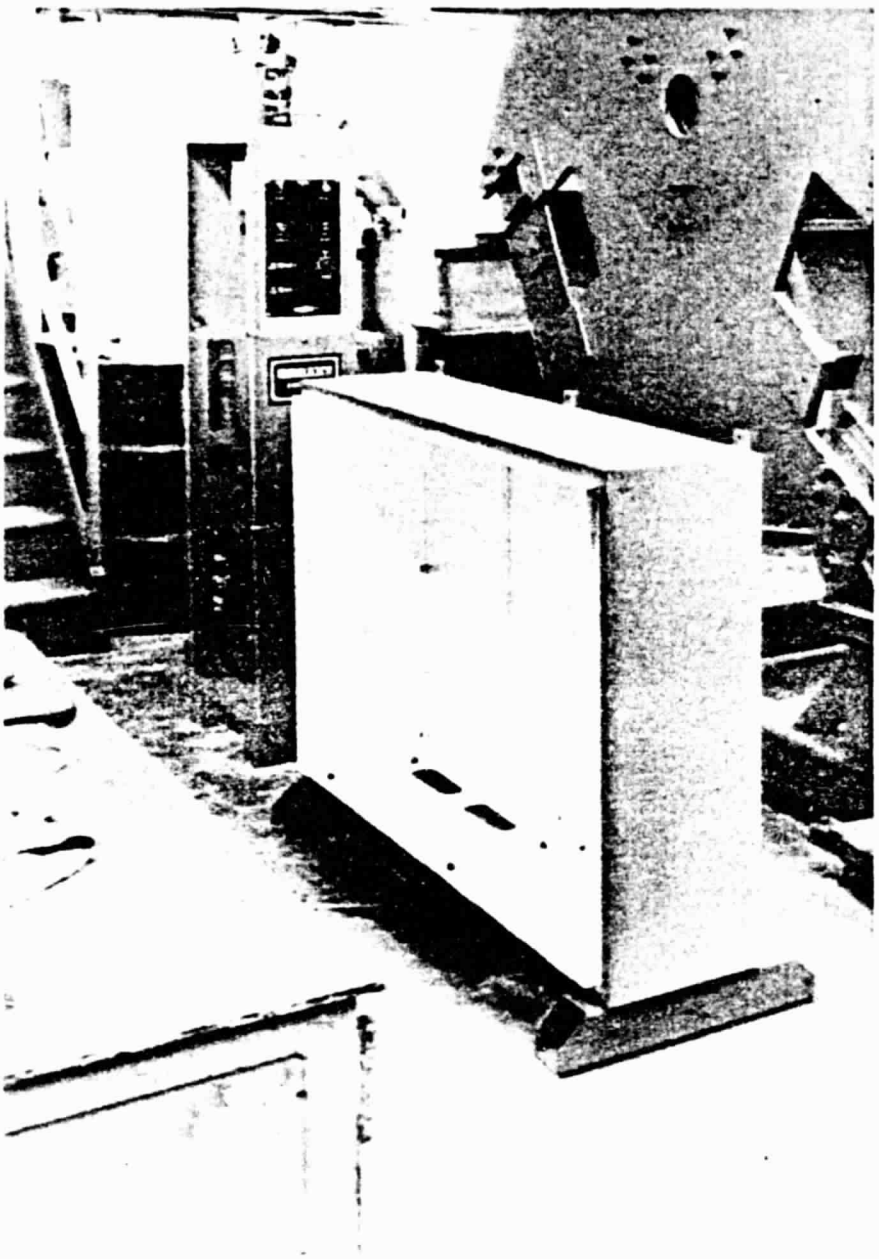
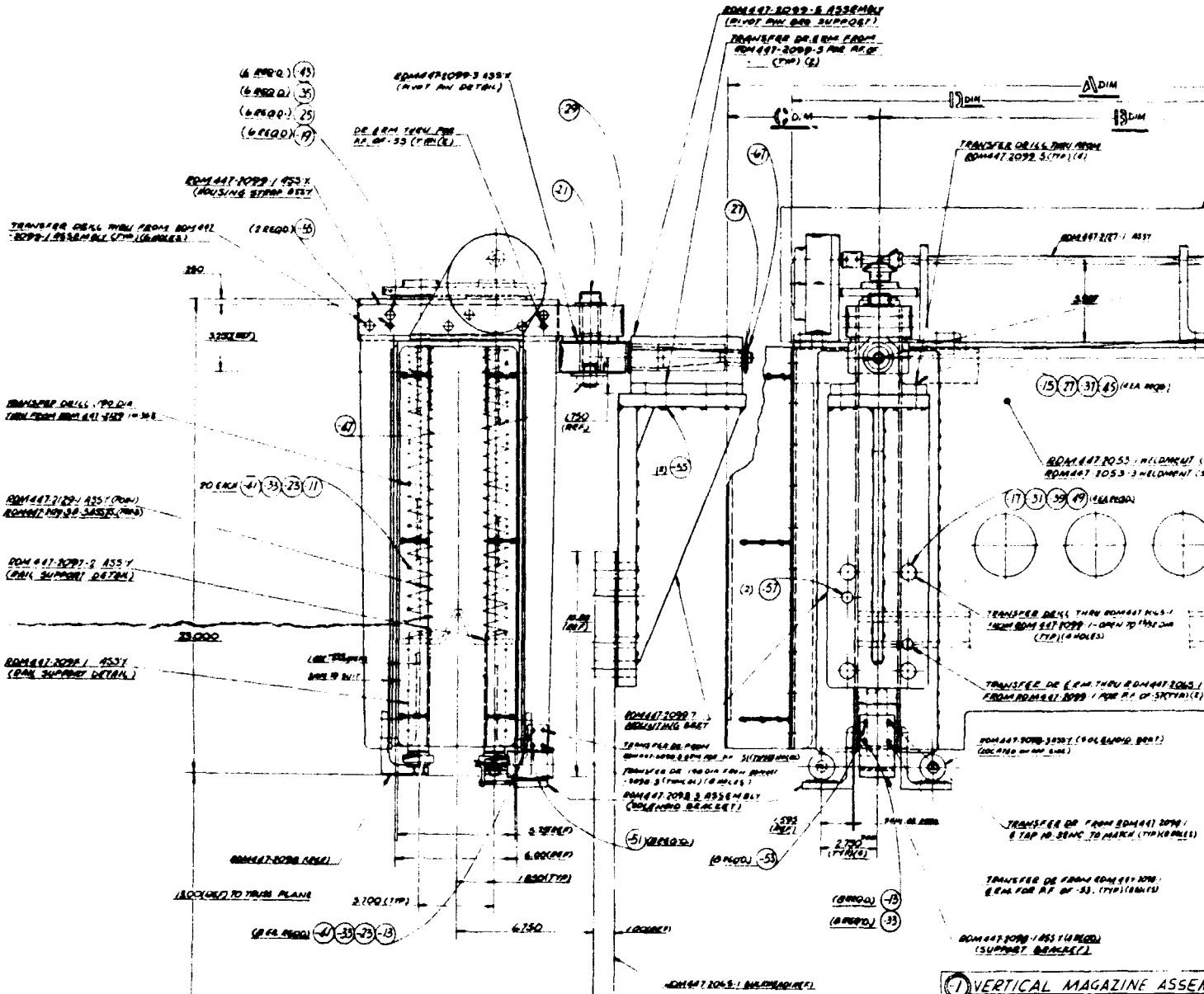


Figure 7 Welding Control Unit



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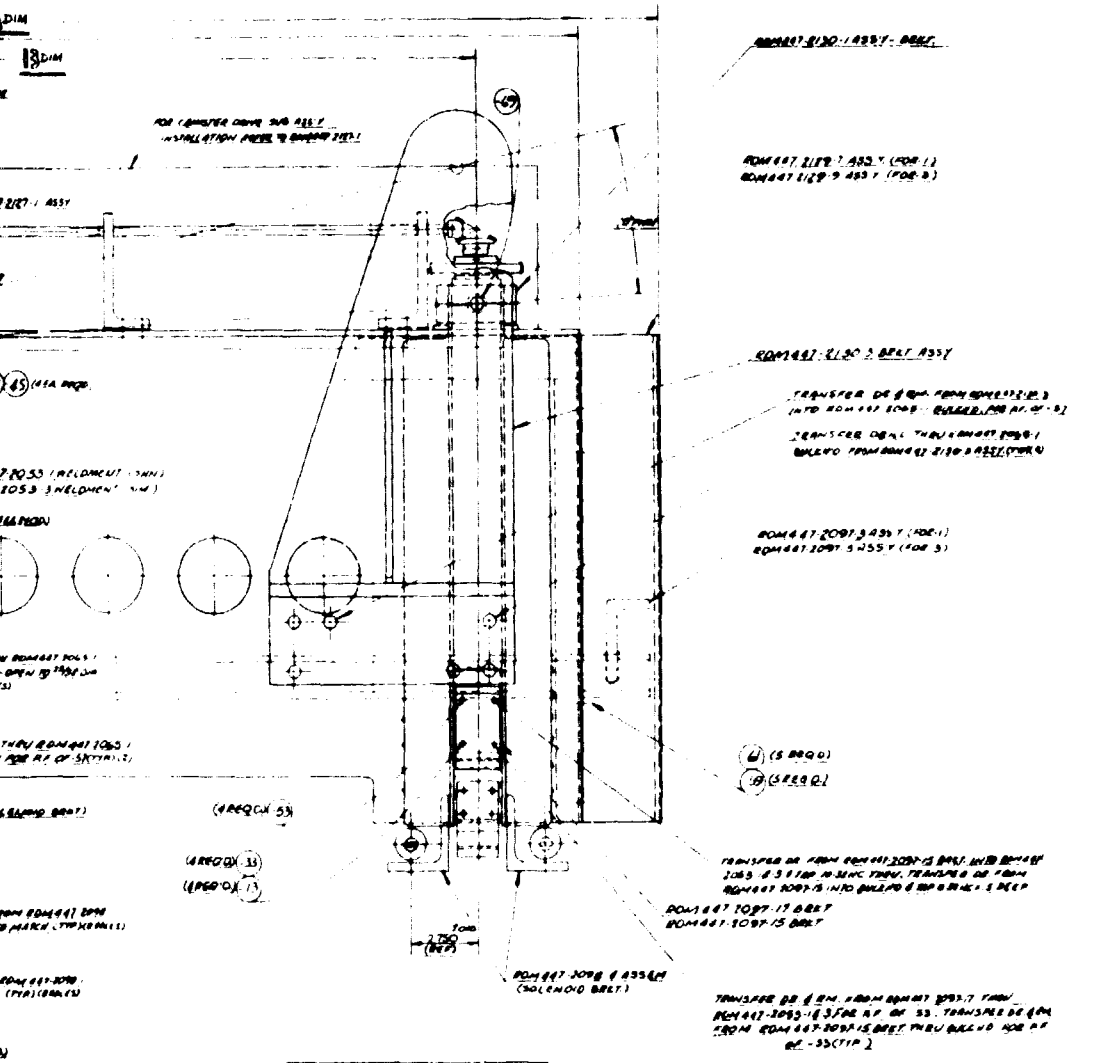

	A DIM	B DIM	C DIM	D DIM
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AZINE ASSEMBLY (SIMILAR)	69.390	30.625	9.382	62.89

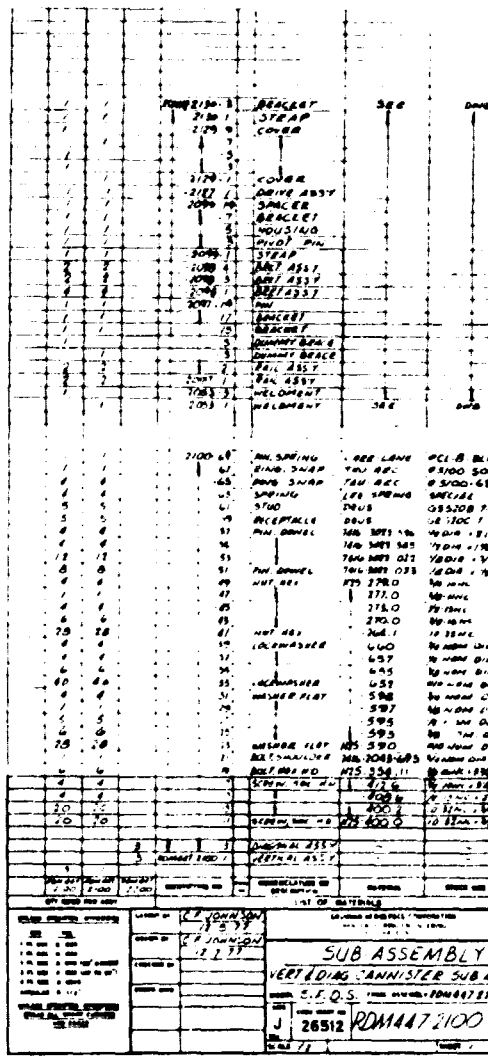

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Figure 8

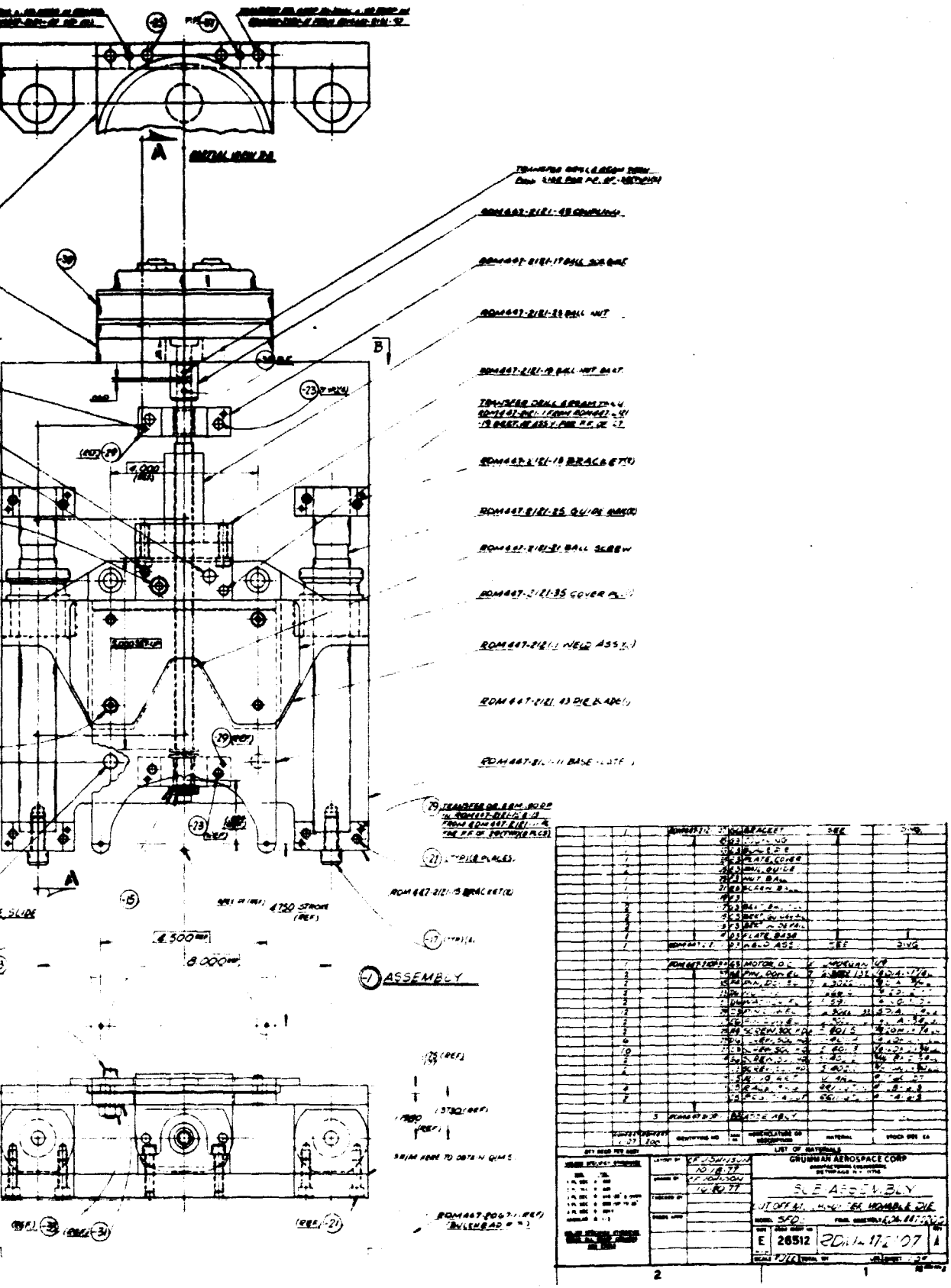

Figure 12

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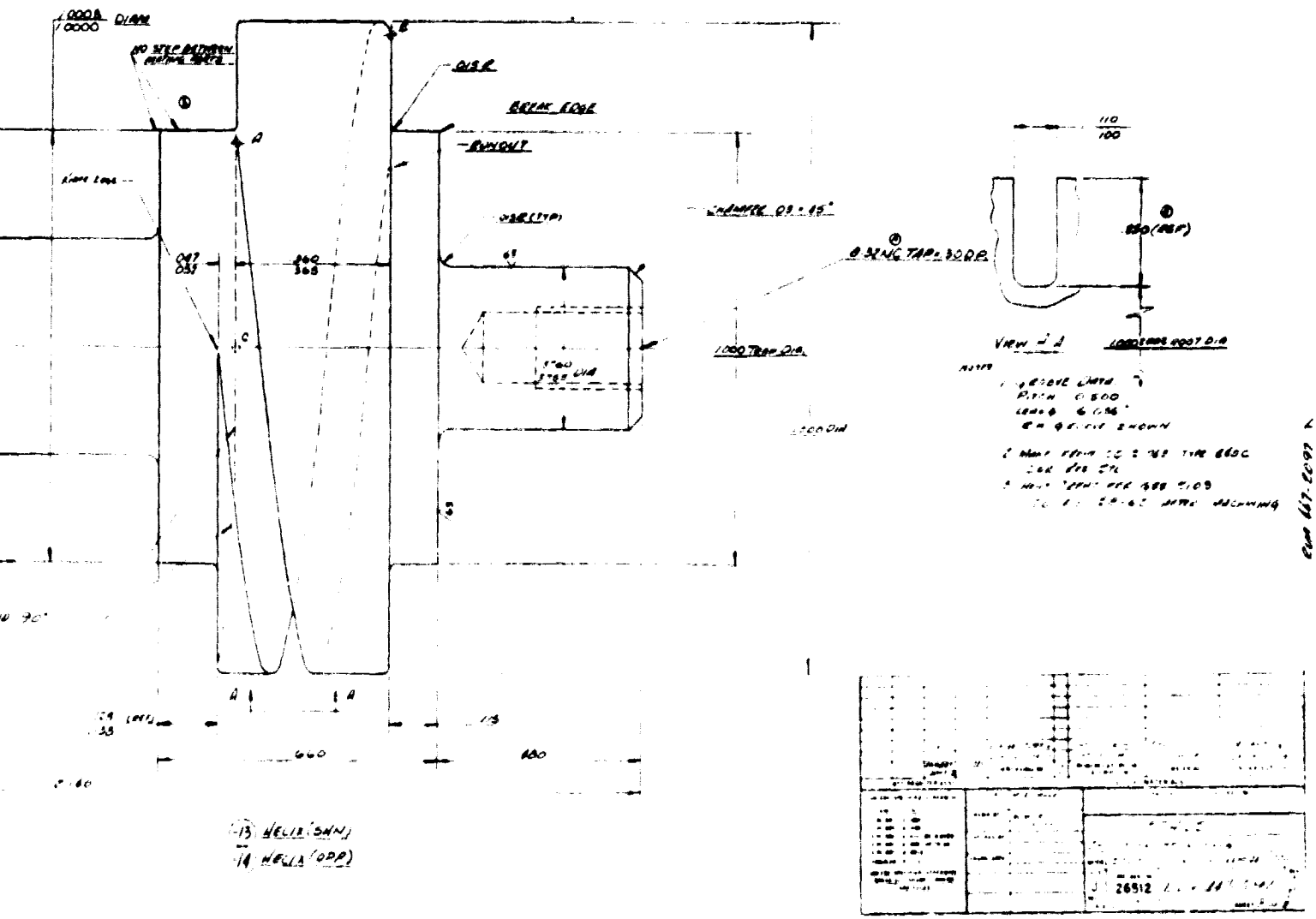

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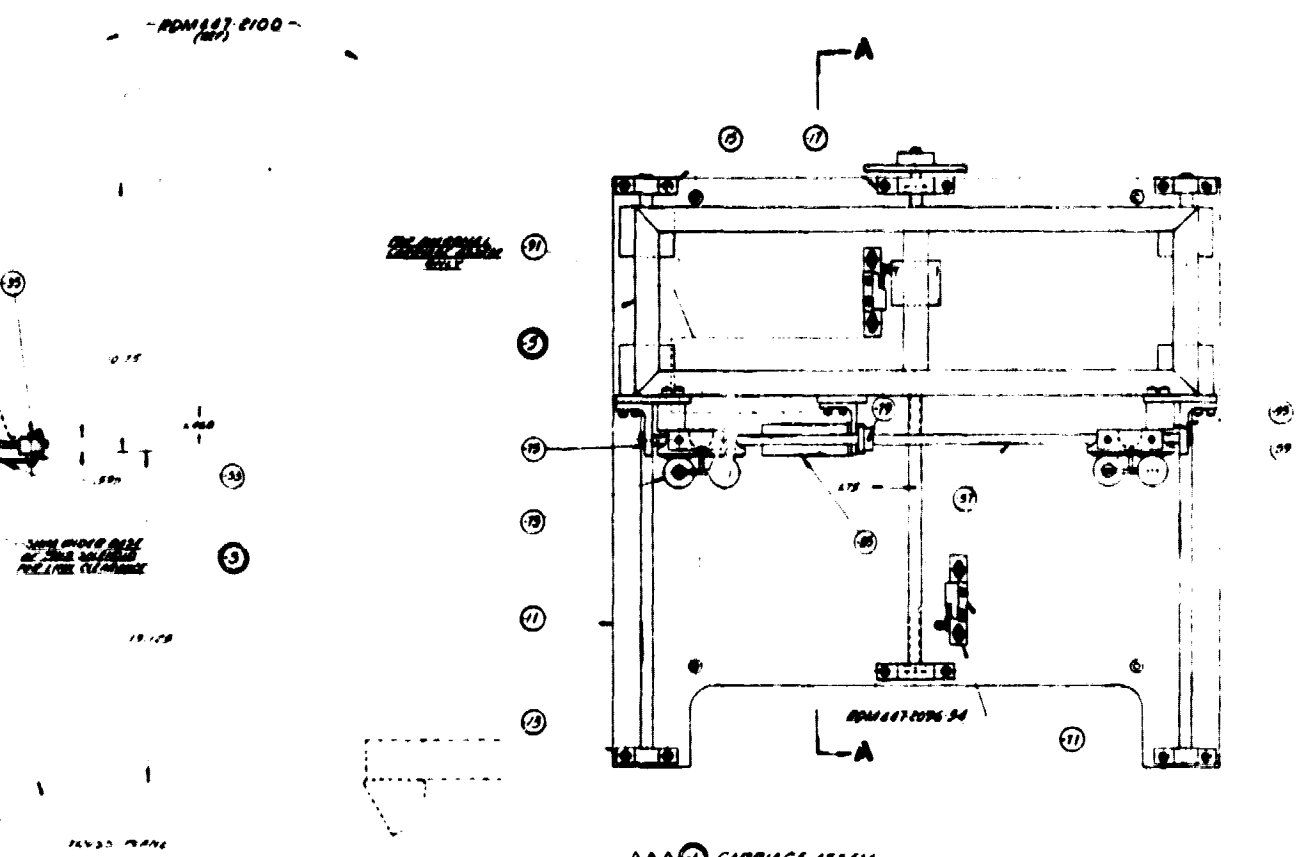
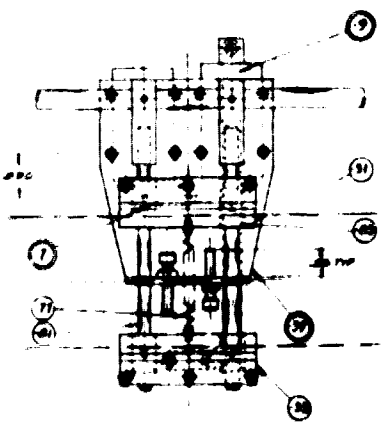
Figure 9



CARRIAGE ASSEM



FINGER ASSEM

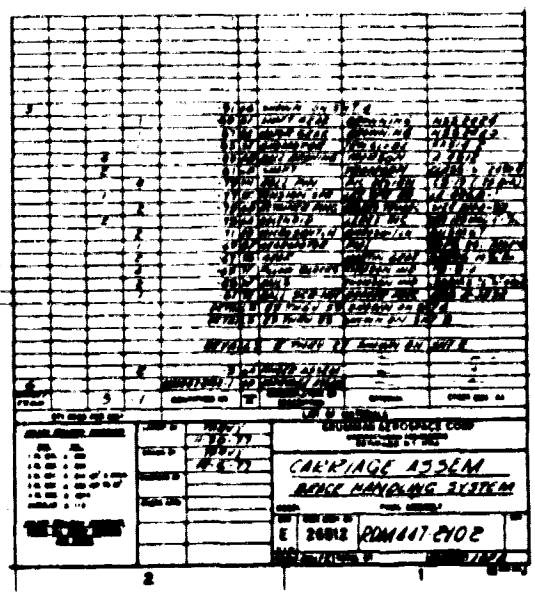


Figure 10

1-12

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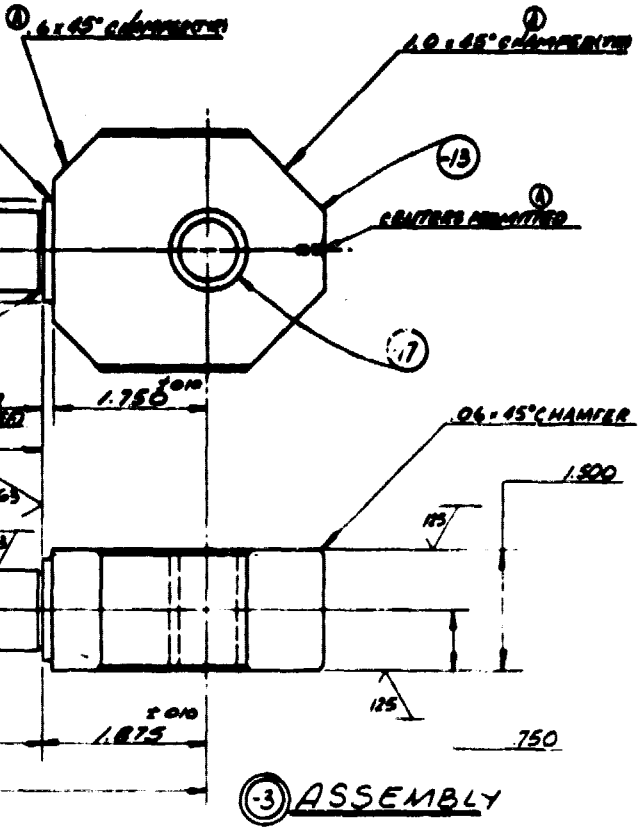

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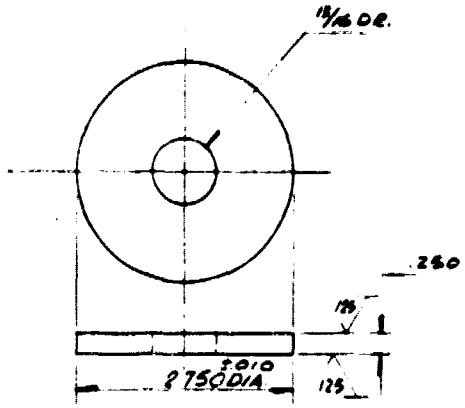

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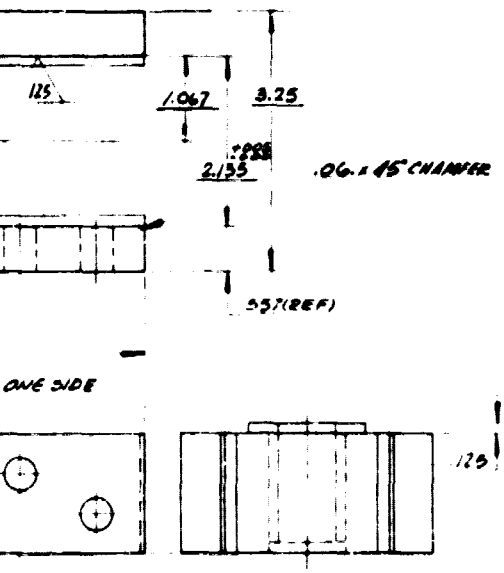

(-1) ASSEMBLY

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	/				-19	07	BUSHING	OILITE	#FF-1013-4
/					-13	05	BLOCK ST ST	304 STAINLESS	1 x 1 x 2 1/2 LG
	/				-17	06	BLOCK ST ST	304 STAINLESS	1 3/4 x 1 3/4 x LG
		/				304	ASSEMBLY		
		/		RDM447-2099	-1	AS	ASSEMBLY		
3	-1	3	-1						
.099	.022	3.00	2.100	IDENTIFYING NO			NOMENCLATURE OR DESCRIPTION	MATERIAL	STOCK SIZE (EA)
QTY REQD PER ASSY							LIST OF MATERIALS		

LAYOUT BY	C F JOHNSEN 12-3-77	GRUMMAN AEROSPACE CORP
DRAWN BY	C F JOHNSEN 12-3-77	DETAILS
CHECKED BY		CANNISTER HI. GE-F. OT
ISSUED BY		MODEL / FINAL ASSEMBLY
		SIZE D / CODE IDENT NO 26512 / RDM447-2099 / REV A
		SCALE FULL / TOTAL WT / LBS / SHEET 1 OF 2

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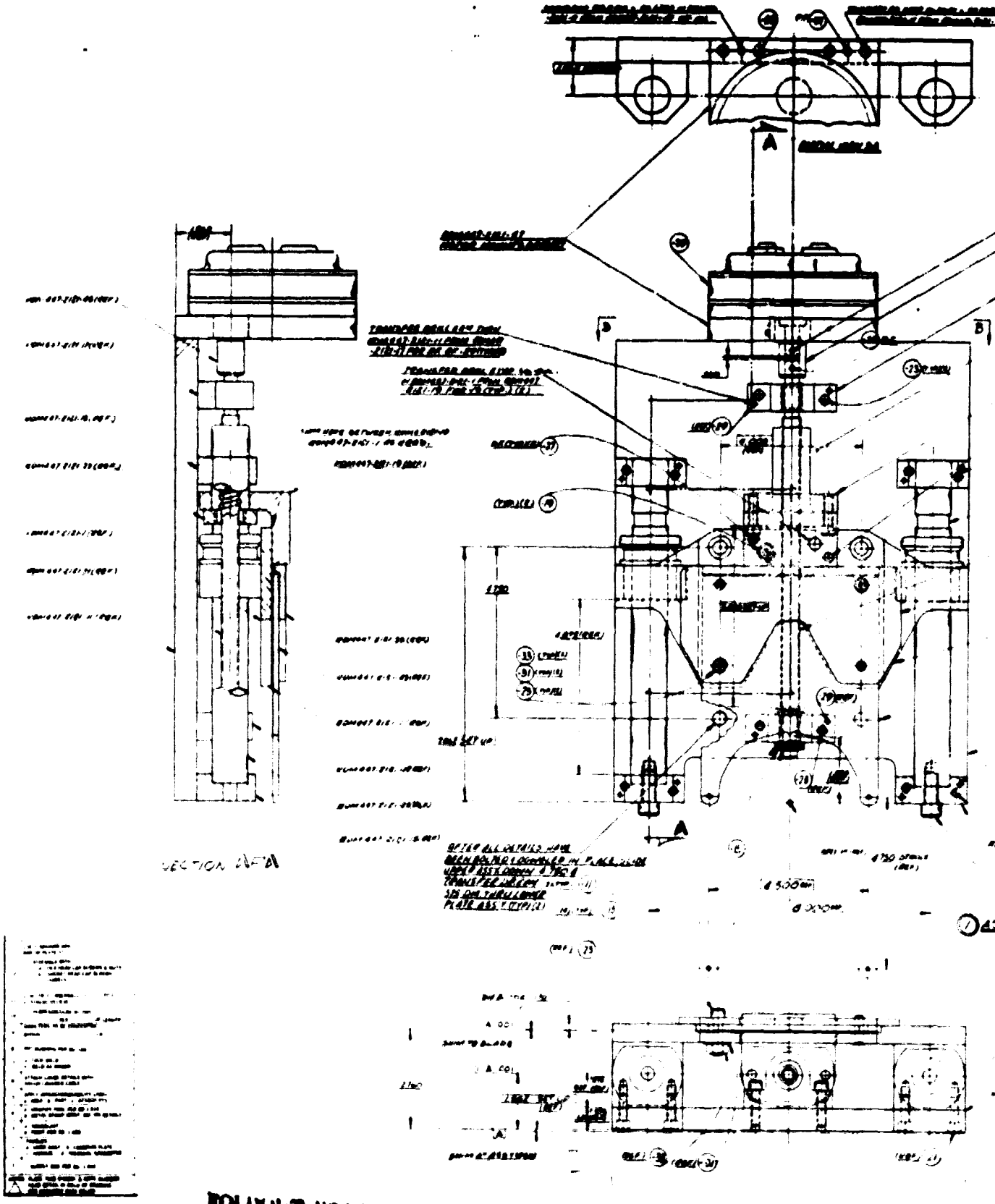
Figure 11



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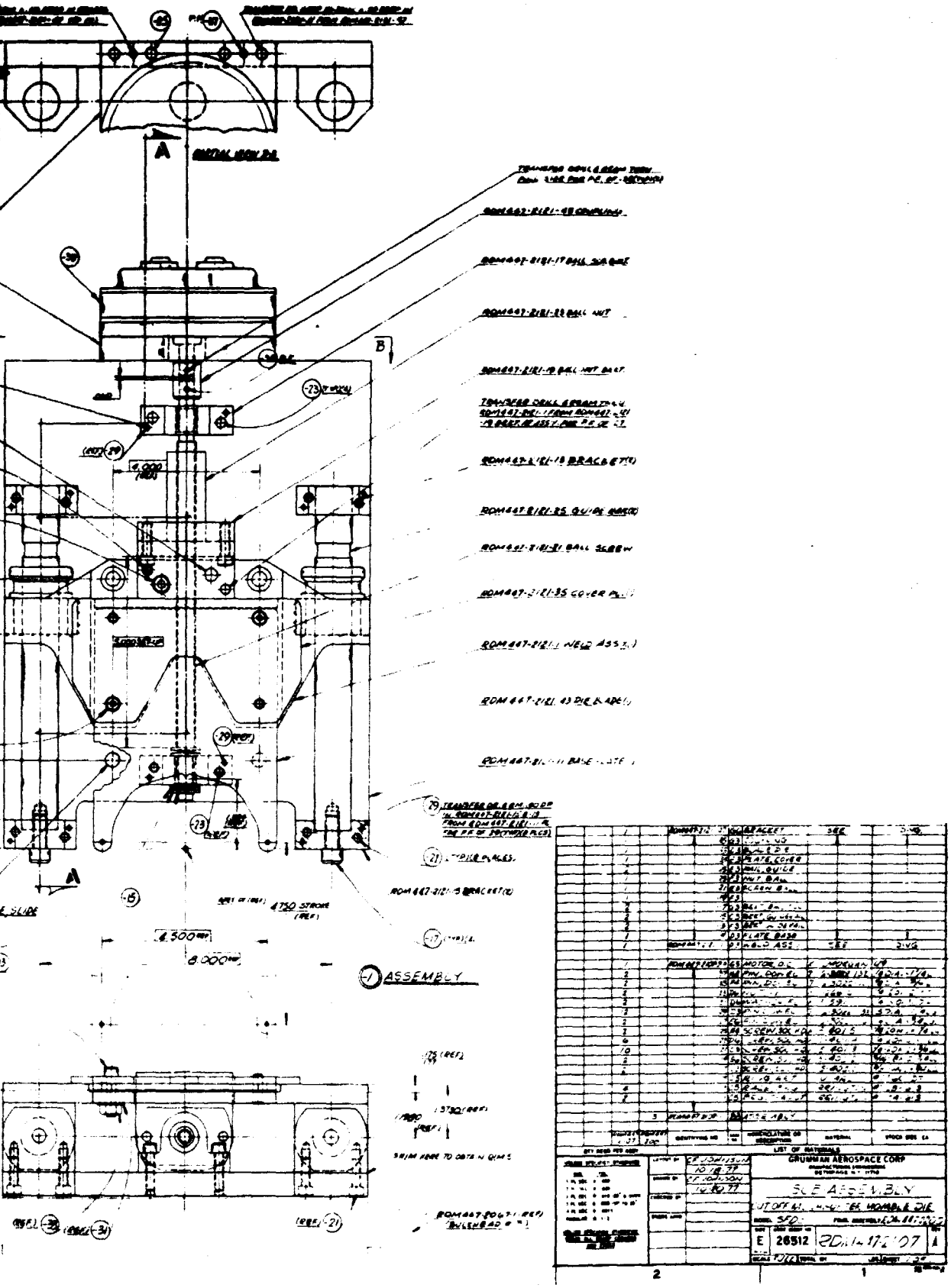

Figure 12

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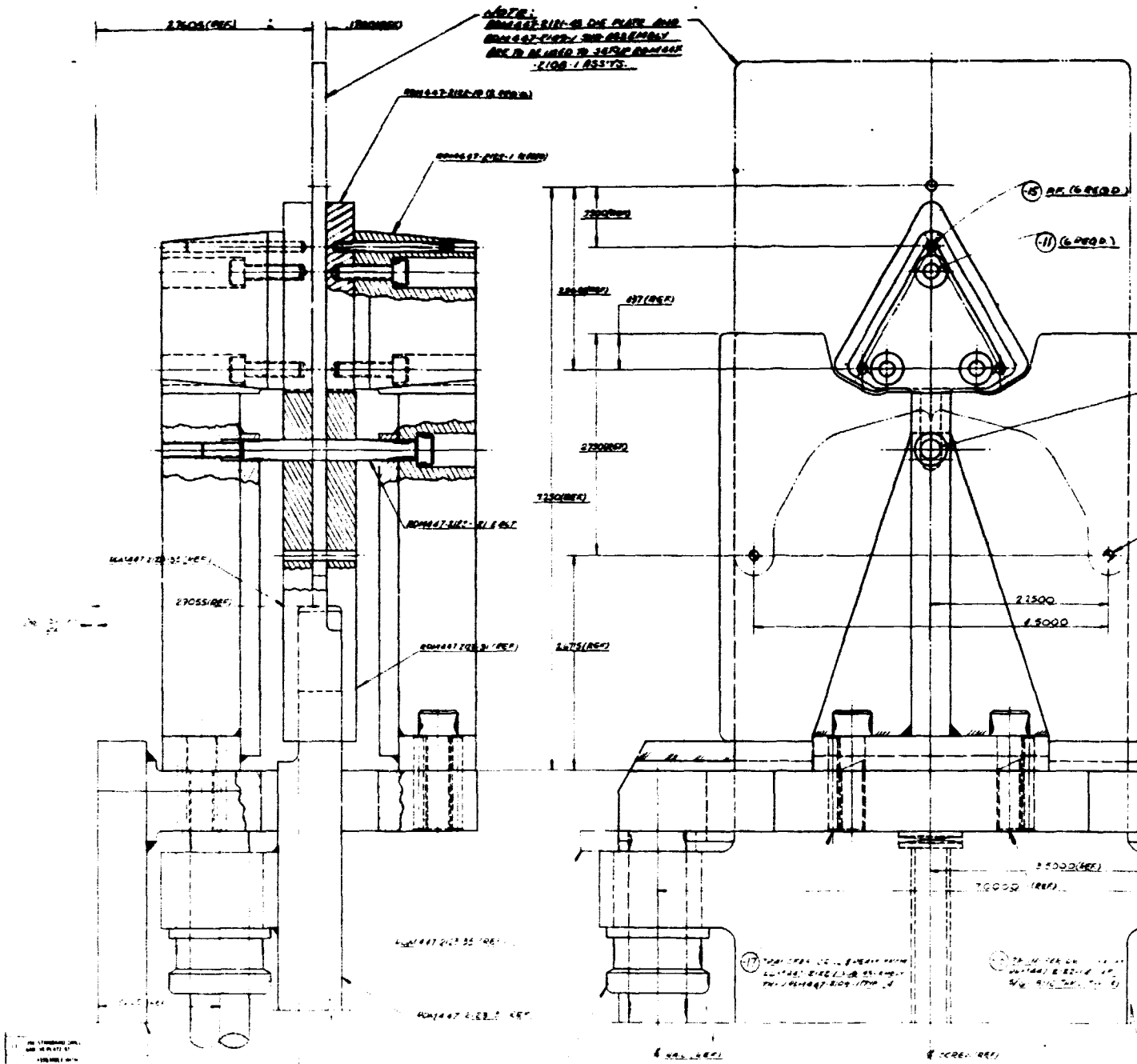

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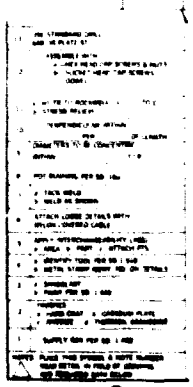
NOTE:



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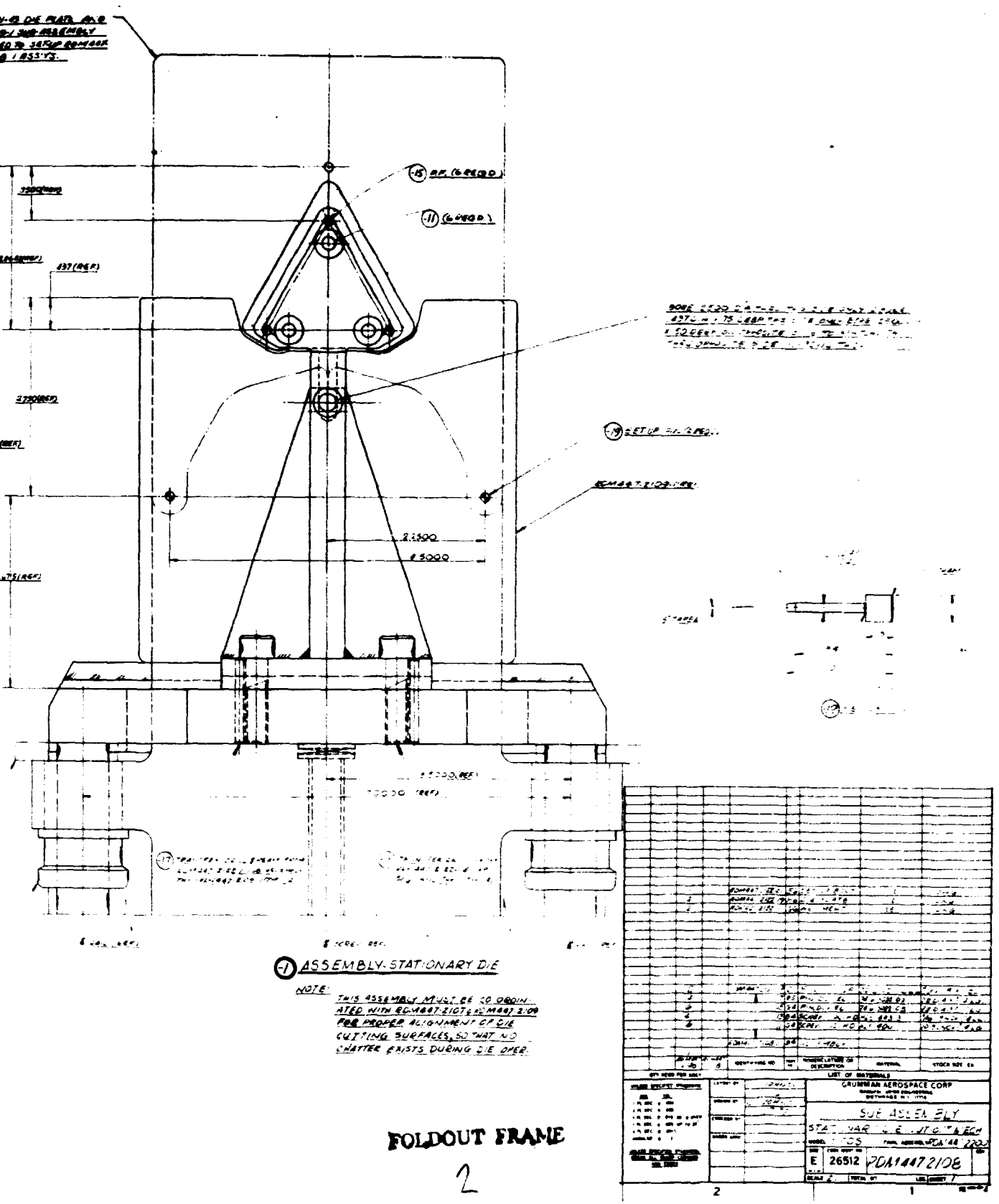

-1 ASSEMBLY-STATIONARY DIE

NOTE

THIS ASSEMBLY MUST BE CO ORDINATED WITH EC M887-2107 & EC M887-2109 FOR PROPER ALIGNMENT OF DIE CUTTING SURFACES, SO THAT NO CHATTER EXISTS DURING DIE OPER.

GRUMMAN AEROSPACE CORP

SUB ASSEMBLY

STATIONARY DIE "A" ECH

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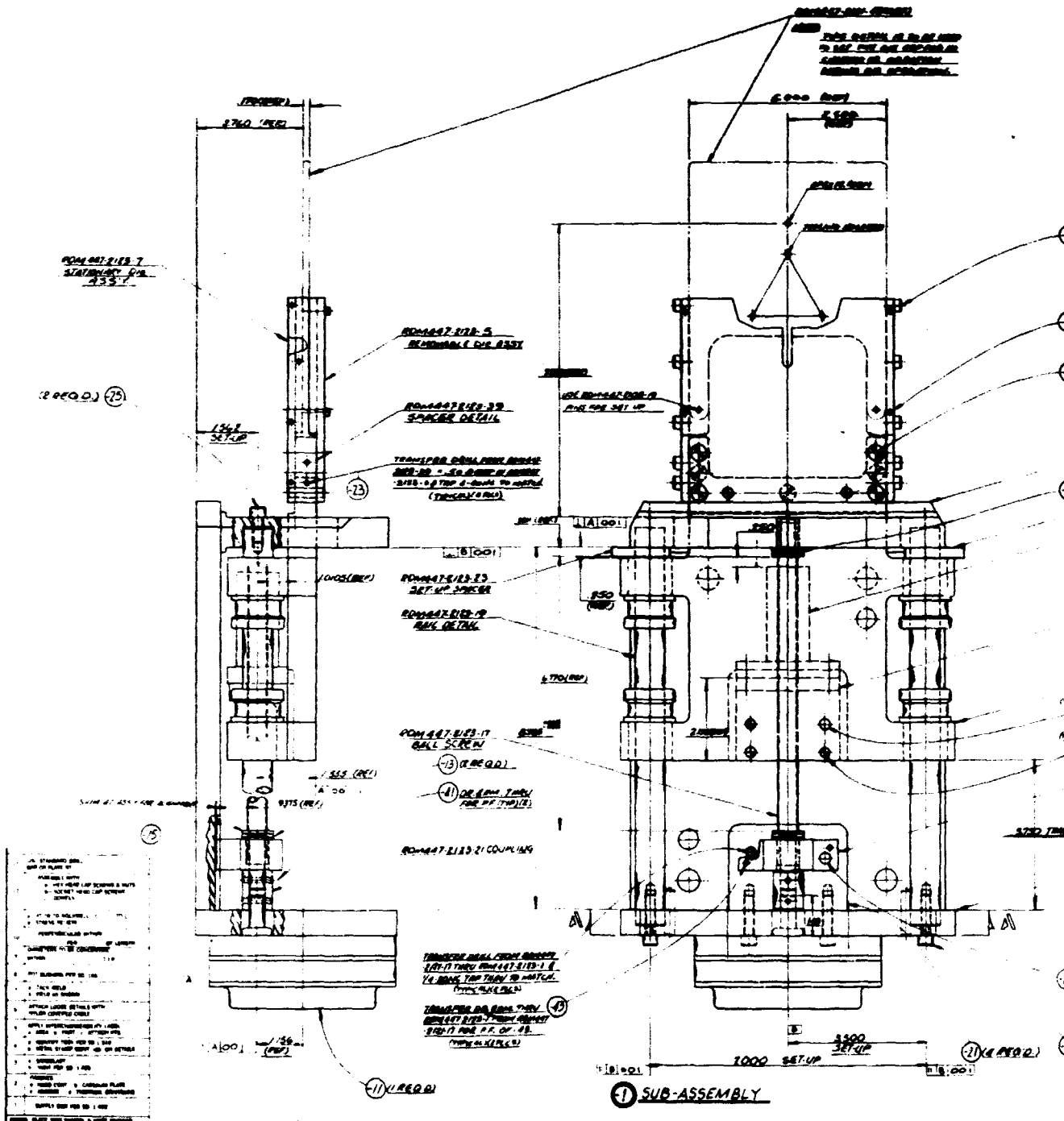
Figure 13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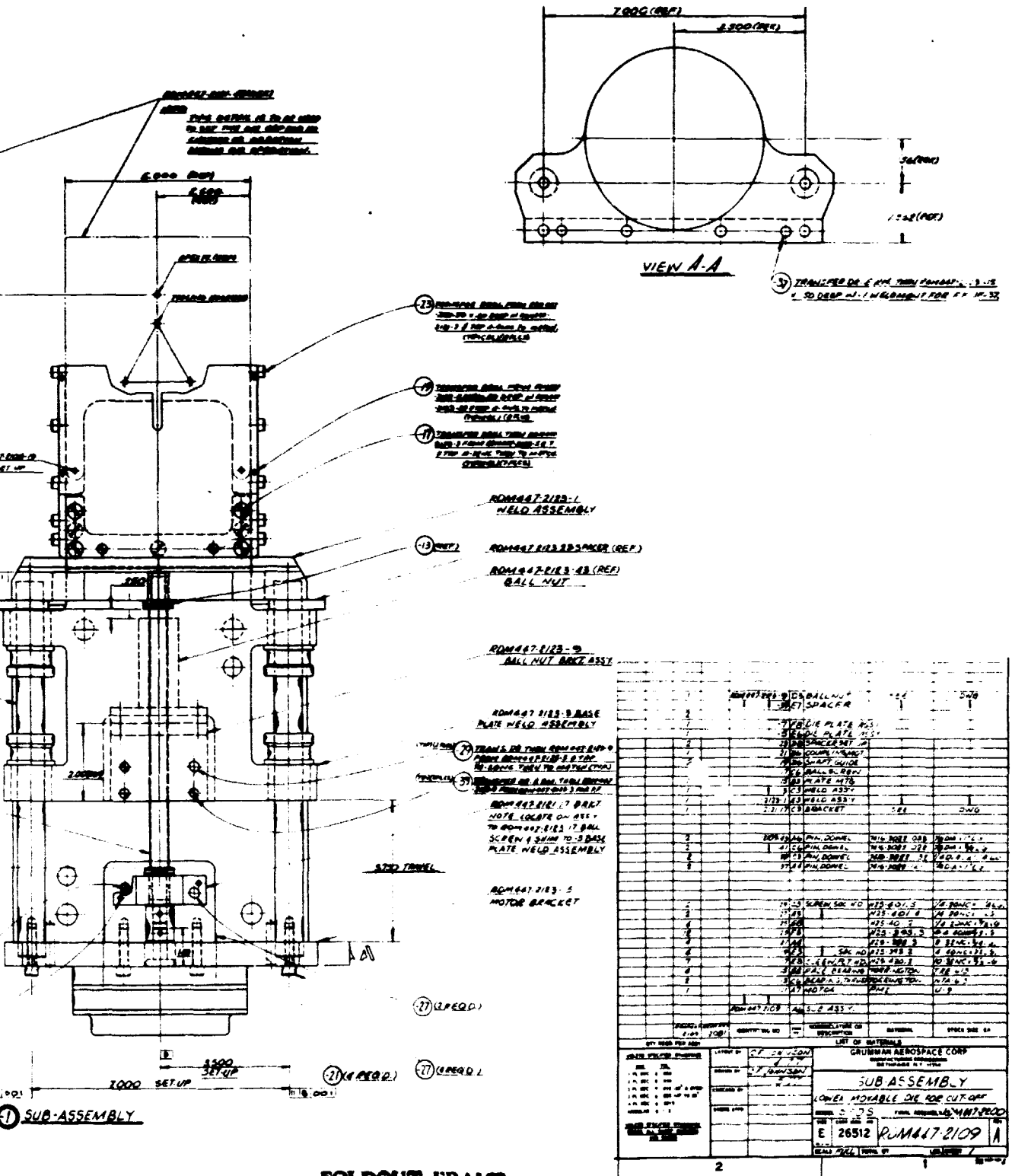

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Figure 14

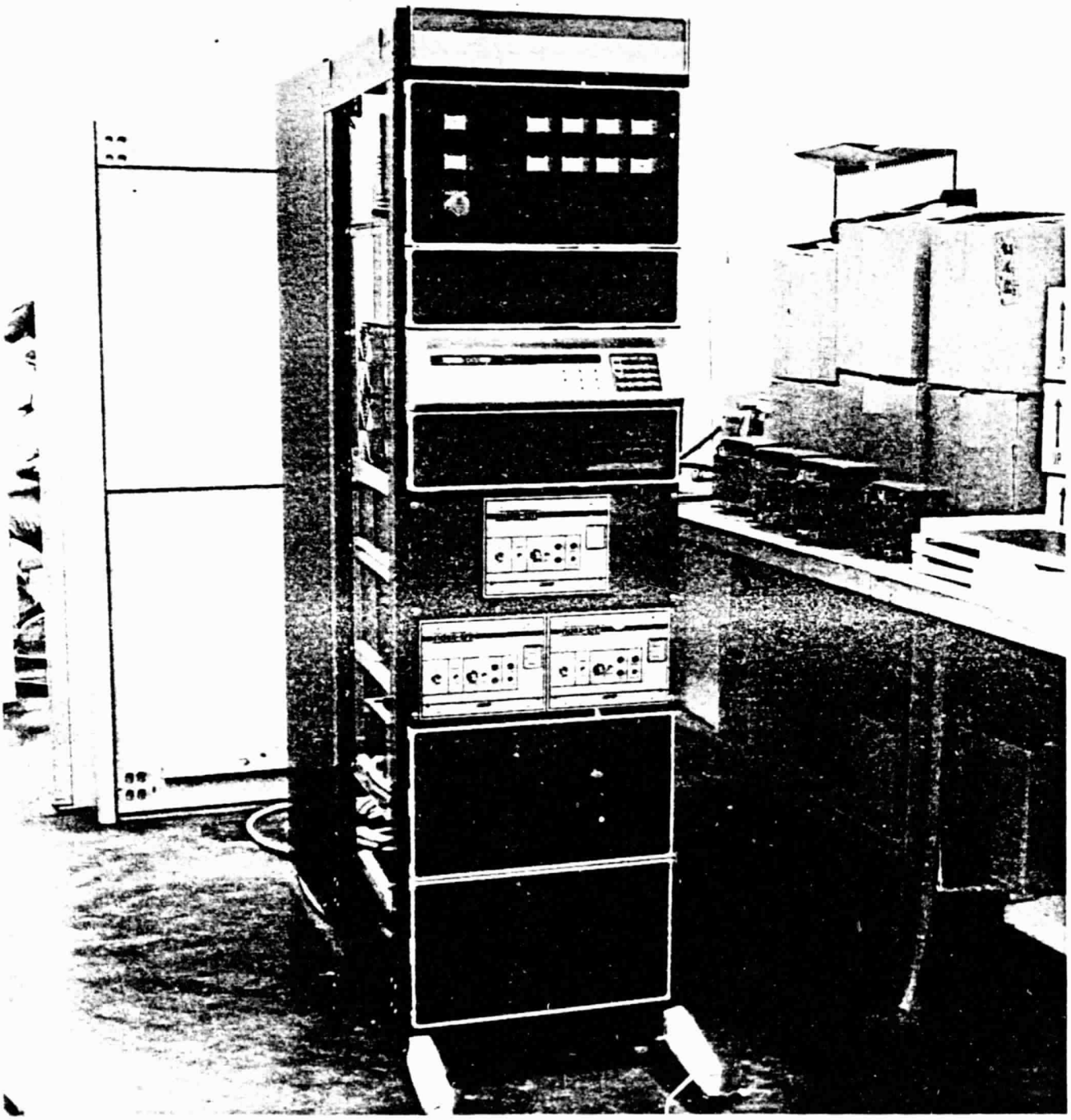

Figure 15 Computer Rack

All detail parts required for the SFDS have been loaded into the shop and are in various stages of completion. A chart depicting the fabrication and sub-assembly status of all the major S.F.D.S component parts is provided in Table II.

1.3.2 ASSEMBLY

The assembly of the S.F.D.S. is well underway with most of the large structural components located on the structure.

Roll Forming

All three bulkheads have been optically aligned and bolted to the previously leveled and cinched down base frame. See Figure 16. All three box beams have been aligned and bolted in place to the bulkheads (Figure 17).

The internal truss support structure was aligned and bolted in place. The first and second Yoder mill base plates were received from the vendor and optically aligned to the box beam structure (Figure 5). All mounting and locating pin holes were drilled and reamed and temporary hardware was installed. These assemblies were then located on their installation tool brackets (ROM447-2083) between bulkheads No. 1 & No. 2 (Figure 18). The alignment pin was inserted in the bushing, picking up the milled slot in the base plate. The assemblies were clamped in place and the mounting brackets installed. The alignment brackets were removed and the mill base plates dis-assembled (Figure 19) and shipped back to the vendor for final assembly of mill, No. 1 and No. 2. Mill No. 3 was received from the vendor and optically aligned to the box beam structure as described above and bolted in place.

The raw material spool sub-assemblies, the Yoder drive sub-assemblies and their mounting brackets have been assembled and are ready for final installation.

Welding and Clamp Mechanism

All of the vertical and diagonal weld block sub-assemblies have been completed and are ready for final installation and alignment.

Controls

The welding control unit has been installed in front of bulkhead No. 1 and power feed lines are being installed.

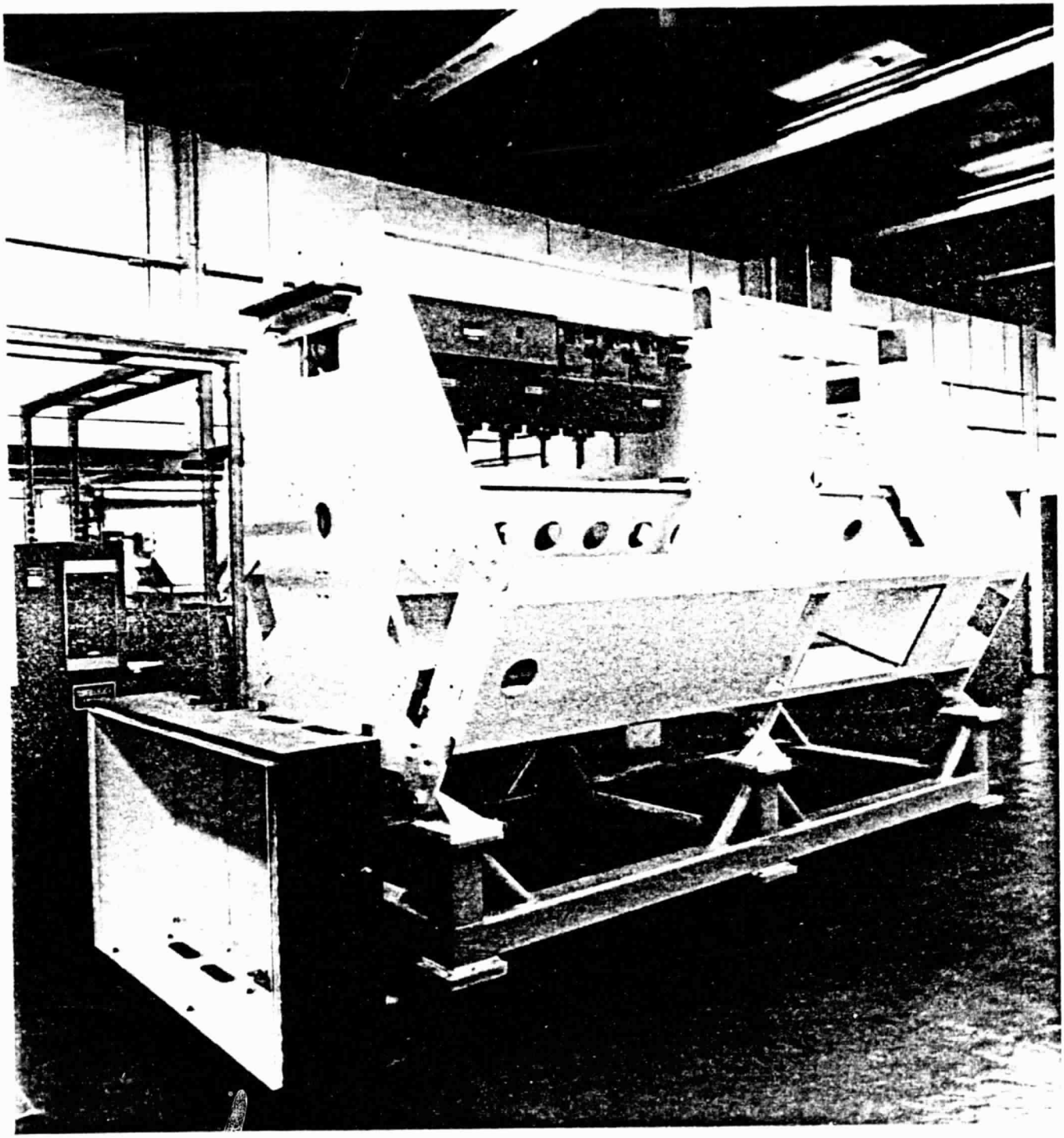

Figure 16 Bulkheads, Box Beams, 1 Mill

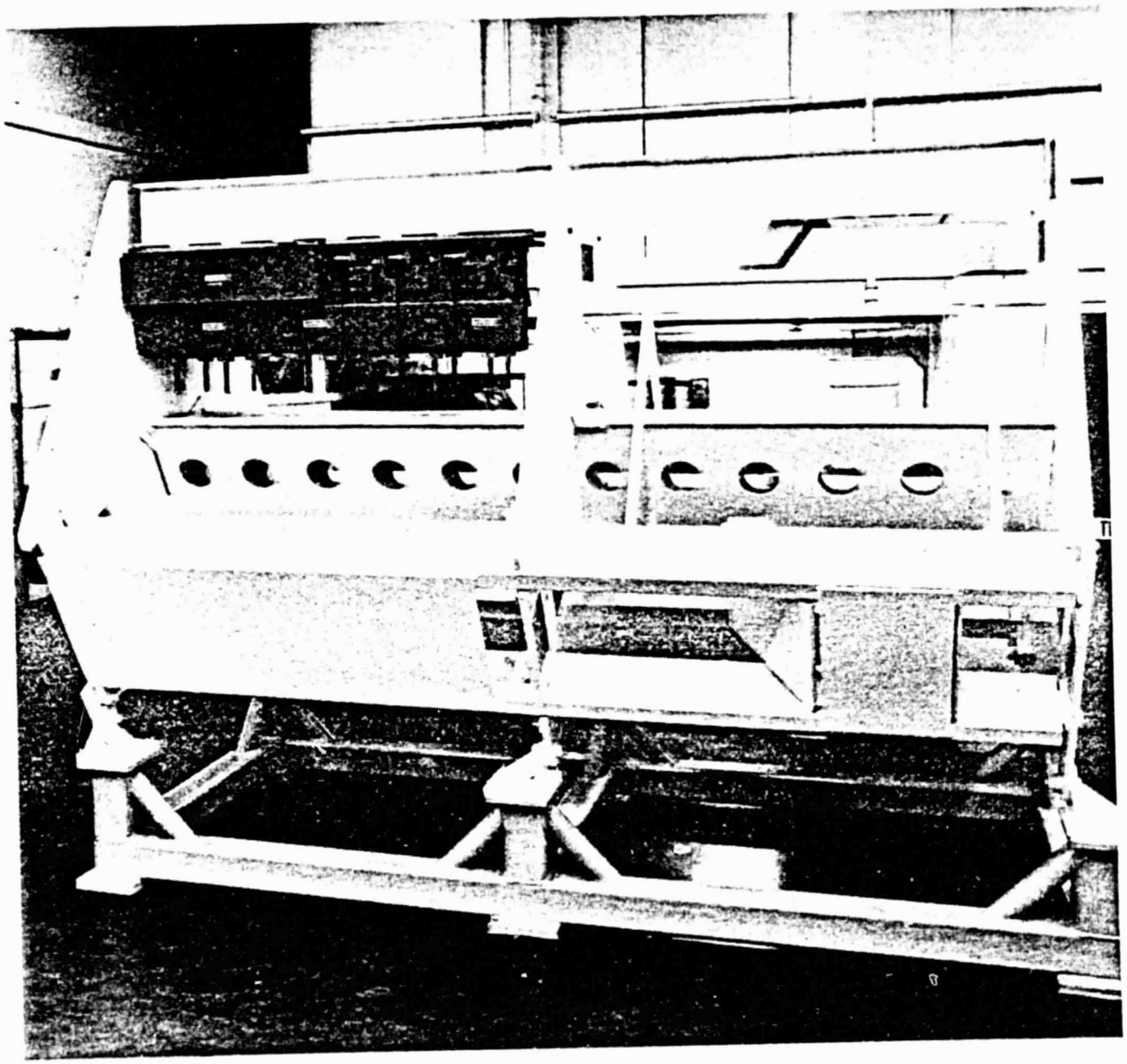

Figure 17 Bulkheads, Box Beam, Internal Structure and 1 Mill

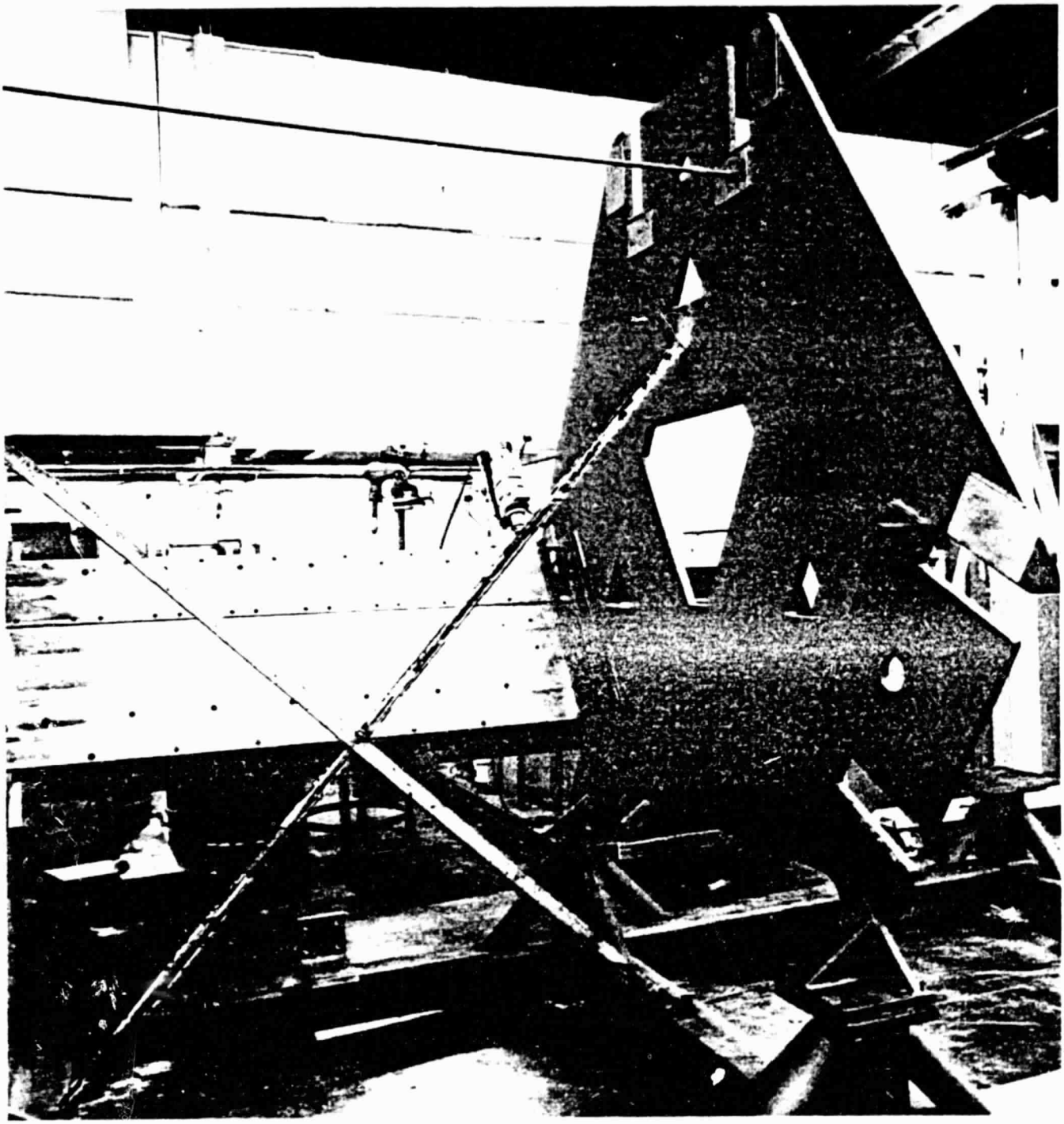

Figure 18 Yoder Mill Bed Plate On
Installation Brackets

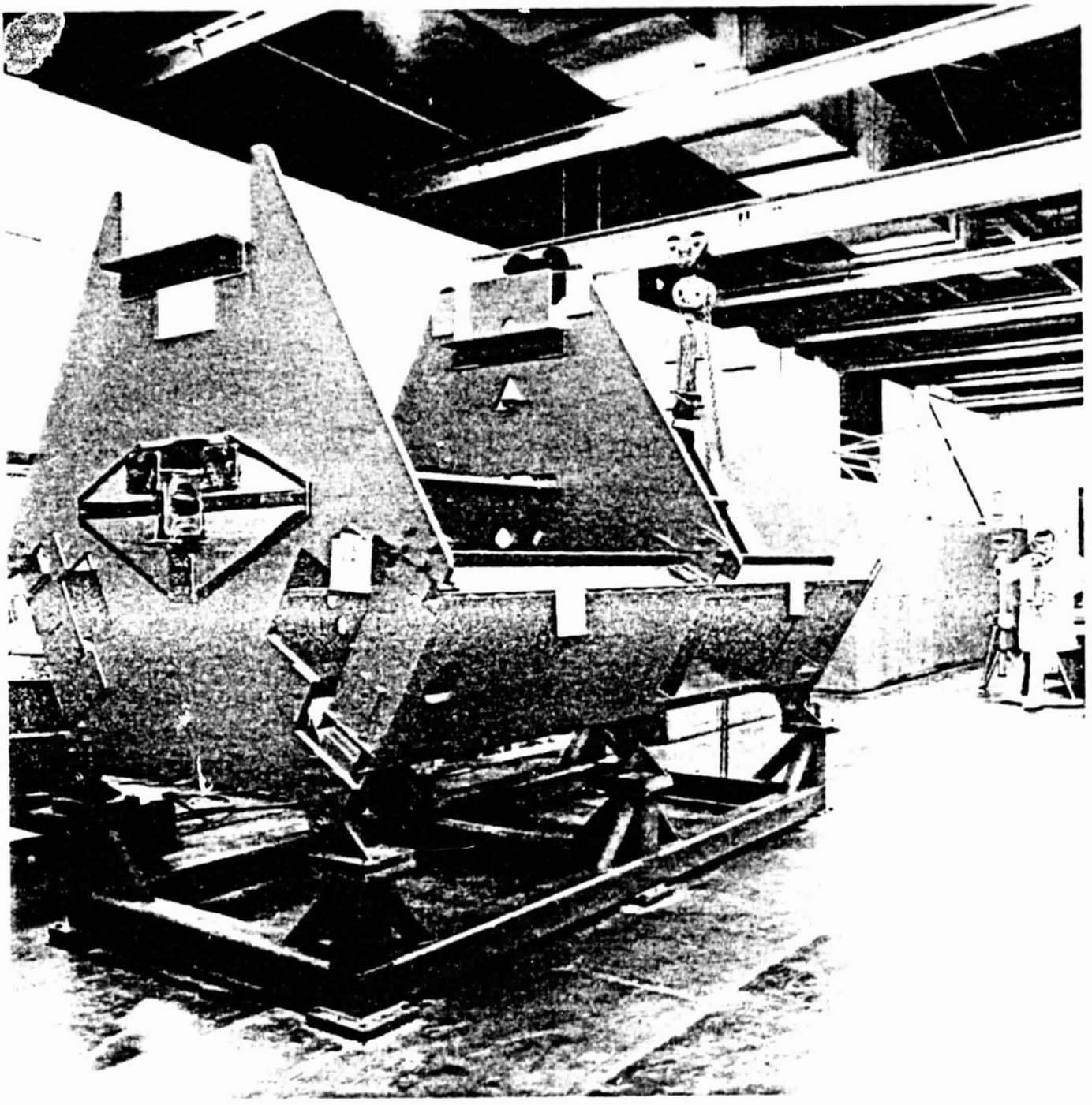

Figure 19 Box Beams Aligned to Bulkheads

Control System Hardware

- o CPU control rack fabrication and checkout is complete (Figure 15)
- o Control relay box wiring is 70% complete and is shown in (Figure 20).

Control System Software

- o Cooling, assembly, and preliminary checkout of Rolling Mill software and system executive routines is complete.
- o Coding and assembly of fastening cycle software is complete with checkout underway.
- o Coding of shear cycle parts program is complete. Coding of the vertical and combined vertical diagonal cycle parts progam is underway.
- o Conceptual design of a utility routine to aid in error recovery is underway. This routine will allow the system operator to control selected motors and solenoids using terminal requests.

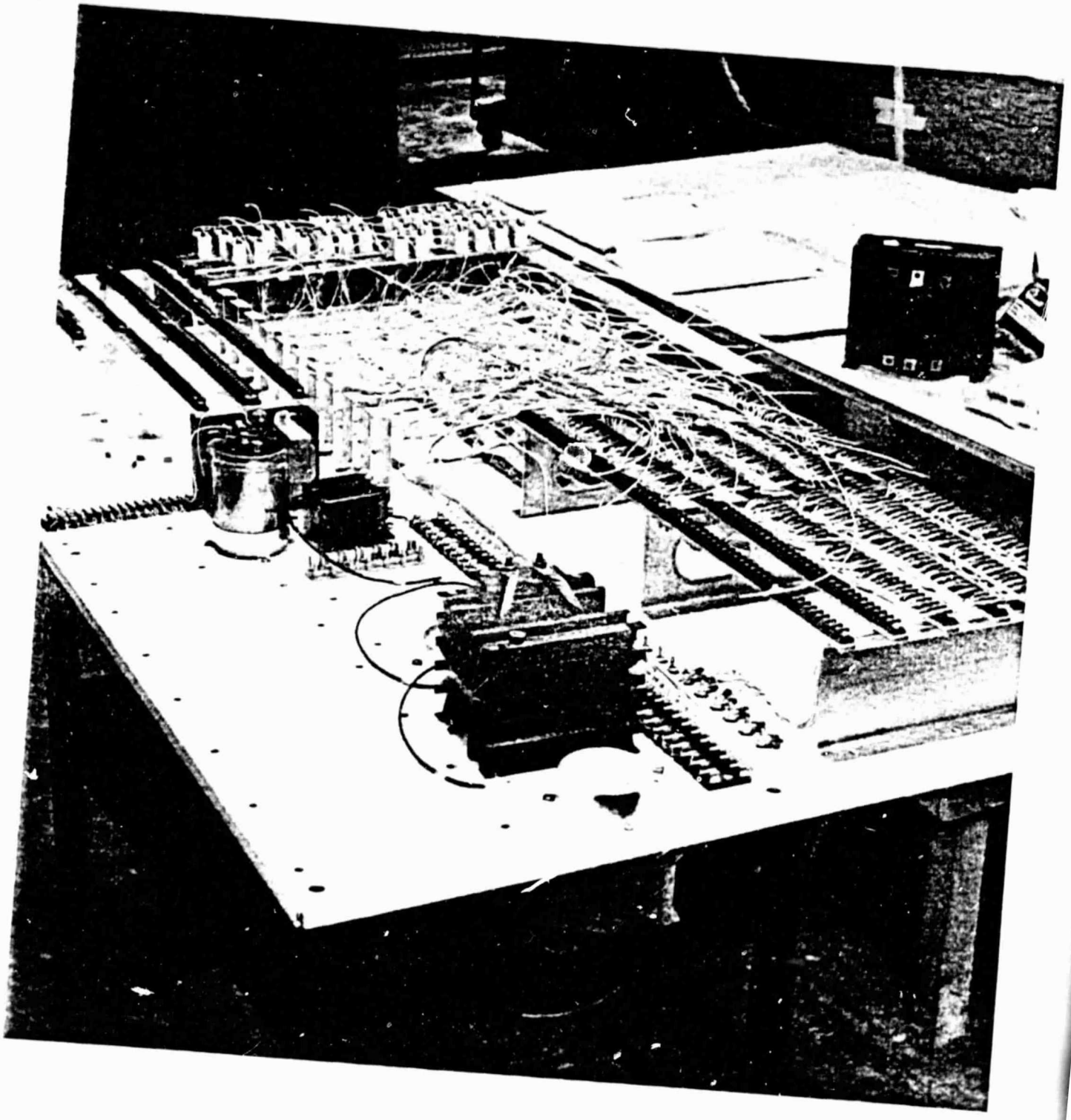

Figure 20 Control Relay Box Wiring

DRAWING NO.	SHT. No.	REV.	DESCRIPTION
RDM447-2050	1	NC	General Configuration
-2053	1	A	Vertical & Diagonal Cannisters
-2060		A	Yoder Roller Base Plate
-2061	1	A	Yoder Roller Sub-assembly
-2061	2	A	Yoder Roller Sub-assembly
-2062	No	Dwg	Bulkh'd. 1,2,3 Flame cut temp.
-2063	1	A	Bulkh'd No.1 weldment ass'y.
-2064	1	NC	Slot Detector bracket
-2065	1	A	Bulkh'd. No.2 weldment ass'y.
-2067	1	B	Bulkh'd. No.3 weldment ass'y.
-2068	1	A	Int. Struct. Mtg. brackets
-2069	1	NC	Int. Weld Block Supports
-2069	2	NC	Int. Weld Block Supports
-2070	1	A	Struct. Sub-ass'y. & alignment
-2070	2	A	Struct. Sub-ass'y. & alignment
-2071	1	A	Yoder Roller-box beam sub-ass'y.
-2072	1	A	Box beam to bulkh'd No.1, No.2, No.3 mtg. brkts
-2072	2	A	Box beam to bulkh'd No.1, No.2, No.3 mtg. brkts
-2072	3	A	Box beam to bulkh'd No.1, No.2, No.3 mtg. brkts
-2073	1	NC	Int. Weld Block support
-2073	2	NC	Int. Weld Block Support
-2076	1	NC	Int. Structure Weldment
-2076	2	NC	Int. Structure Weldment
-2076	3	NC	Int. Structure Weldment
-2076	4	NC	Int. Structure Weldment
-2077	1	A	Base frame weldment
-2078	1	NC	Bulkh'd. to base mtg. bracket
-2081	1	Adv.	Cut-off mechanism ass'y.
-2082	1	A	Box Beam Weldment
-2082	2	A	Box Beam Weldment
-2083	1	A	Yoder Mill Installation Bracket
-2085	1	NC	Raw Mat 'l Spool Ass'y.
-2085	2	NC	Raw Mat'l Spool Details
-2091	1	NC	Scissor Mechanism Details
-2091	2	NC	Scissor Mechanism Details
-2091	3	NC	Scissor Mechanism Details
-2091	4	NC	Scissor Mechanism Details
-2092	1	A	Weld Block Ass'y
-2092	2	A	Weld Block Ass'y
-2093	1	NC	Scissor Details
-2093	2	NC	Scissor Details
-2094	1	NC	Weld Block Details
-2095	1	NC	Scissor Details
-2096	1	NC	Weld Block Ass'y
-2096	2	NC	Weld Block Ass'y
-2096	3	NC	Weld Block Ass'y
-2097	1	A	Cannister Brkt Details
-2097	2	A	Cannister Helix Detail
-2097	3	NC	Cannister Dummy Brace
-2098	1	NC	Cannister Bracker Details
-2099	1	A	Cannister Strap & Pivot Pets
-2099	2	A	Cannister Hinge Mtg. Brkt.
-2099	3	NC	Cannister mtg. bracket
-2100	1	NC	Cannister sub-assembly
-2102	1	NC	Carriage ass'y.
-2102	2	A	Carriage details
-2102	3	NC	Carriage details

DRAWING NO.	SHT. No.	REV.	DESCRIPTION
RDM447-2102	4	NC	Carriage details
-2102	5	NC	Carriage details
2103	1	NC	Clamp ass'y-Aft diag. brace
-2103	2	NC	Clamp ass'y-Aft diag. brace
-2104	1	NC	Clamp ass'y-Fwd diag brace
-2104	2	NC	Clamp ass'y-Fwd diag brace
-2107	1	A	Cut-off Mech. Upper Sub-assy
-2108	1	NC	Cut-off Mech. Middle Sub-assy
-2109	1	A	Cut-off Mech. Lower Sub-assy
-2112	1	NC	Yoder Drive Sub-assy
-2115	1	2-28-78	Drawing tree
-2116	1	NC	Int. Support brkt-weld block
-2116	2	NC	Int. Support brkt-weld block
-2117	1	NC	Installation Template
-2118	1	NC	Installation Template
-2119	1	NC	Geometry sheet
-2120	1	NC	Int. Weld block Installation Temp.
-2121	1	A	Cut-off Mech-upper details
-2121	2	A	Cut-off Mech-upper details
-2122	1	NC	Cut-off Mech-middle details
-2123	1	A	Cut-off Mech-lower details
-2123	2	A	Cut-off Mech-lower details
-2125	1	A	Cannister drive details
-2126	1	NC	Cannister drive details
-2127	1	A	Cannister drive assembly
-2129	1	A	Cannister end cap ass'ys.
-2129	2	A	Cannister end cap ass'ys.
-2130	1	NC	Cannister latch details mtg. brkt.
-2130	2	NC	Cannister strap at latch end
-2130	3	NC	Cannister mtg brkt det
-2131	1	NC	Diagonal support structure
-2132	1	NC	Feed spool details
-2133	1	NC	Feed spool details
-2133	2	NC	Feed spool details
-2136	1	NC	Feed spool assembly
-2137	1	NC	Transformer mtg plates
-2138	1	NC	Yoder drive bushing
-2139	1	NC	Mat'l. hoist
-2001		NC	Assembly diagram
-2002		NC	System cabling
-2003		NC	Interface rack utilization
-2004		NC	Control panel configuration
-2005		NC	Control system functional diagram
-2006		NC	Lamp drivers & switch duffers
-2007		NC	Processor rack layout
-2010		NC	Material position registers
-2011		NC	Voltage controlled Oscillator & Linear Ramp Gen
-2012		NC	Fifo buffer & control
-2013		NC	Isolators & line drivers
-2014		NC	Slot sense detectors
-2015		NC	Limit switch wiring
-2016		NC	Motor control relay junct. box ass'y.
-2017		NC	Motor control relay junct. box details
-2018		NC	Typical motor, solenoid control circuits
-2019		NC	115VAC power supply control
-2020		NC	Motor power supplies
-2200			Final ass'y.

Table II Status of Detail Parts and Sub-ass'ys.

SFDS COMPONENTS	DESIGN	DRAWING	SHOP LOAD	DET. WELD	DET. MACH.	PAINT	SUB-ASSY	INST.
STRUCTURE								
BOX BEAM WELDMENTS	o	o	o	o	o	o	o	o
BASE FRAME WELDMENT	o	o	o	o	o	o	o	o
BULKHD WELDMENTS	o	o	o	o	o	o	o	o
INTERNAL STRUCTURE	o	o	o	o	o	o	o	o
DIAGONAL SUPPORT STR	o	o	o	o	o	o	o	o
MOUNTING BRACKETS	o	o	o	NA	o	o	o	o
WELD BLOCK ASSEMBLYS								
VERTICAL WELD BLOCK	o	o	o	o	o	o	o	
VERTICAL SCISSORS	o	o	o	o	o	o	o	
DIAG. WELD BLOCK	o	o	o	o	o	o	o	
DIAG. SCISSORS	o	o	o	o	o	o	o	
INTERNAL WELD BLOCK	o	o	o	NA				
MAGAZINE DISPENSER								
VERTICAL WELDMENT	o	o	o	o	o			
DIAGONAL WELDMENT	o	o	o	o	o			
DRIVE ASSEMBLIES	o	o	o	NA	o			
END CAP ASSEMBLIES	o	o	o	o	o	o		
STORAGE DETAILS	o	o	o	o	o			
MOUNTING BRACKETS	o	o	o	NA	o	o	o	
MAGAZINE CARRIAGES								
VERTICAL WELDMENTS	o	o	o	o	o			
DIAGONAL WELDMENTS	o	o	o	o	o			
DRIVE ASSEMBLIES	o	o	o	NA	o			
MOUNTING BRACKETS	o	o	o	NA	o			
MISCELLANEOUS ITEMS								
YODER MILL No. 1	o	o	o	NA	o	o		
YODER MILL No. 2	o	o	o	NA	o	o		
YODER MILL No. 3	o	o	o	NA	o	o	o	o
YODER DRIVE ASS'YS	o	o	o	o	o	o	o	
RAW MAT'L SPOOL ASS'YS	o	o	o	o	o	o	o	
FEED SPOOL ASS'YS	o	o	o	o	o			
CUT-OFF MECH. ASS'YS	o	o	o	o	o			
WELDING CONTROL UNIT	o	o	o	NA	NA	o	o	o
TRANSFORMERS & BRKTS	o	o	o	NA	o	o	o	
BUSS BARS	o							
COMPUTER	o	o	NA	NA	NA	NA	o	o

ENCLOSURE (2)

SFDS-REDUCED QUANTITY ATTACHMENT SPOTWELDS

GRUMMAN

MEMORANDUM

CHECK (✓) BOXES AS APPROPRIATE

ACTION..... ☐
INFO ONLY..... ☐
REPLY REQUESTED... ☐

FROM:	NAME	GROUP NO. & NAME	PLANT NO. COMPANY	EXT.	DATE
	W. Marx,	Advanced M&P Development,	A04-12	7362	27 January 1978
TO: ✓	W. Muench	Prog. Mgt. Space	A09-25	2097	NO. MP-AMPD-MO-78-15

SUBJECT: SFDS-REDUCED QUANTITY ATTACHMENT SPOTWELDS

Introduction

The initial SFDS truss design utilized 8 spotwelds per brace attachment as shown in Figure 1. A reduction from eight to six spotwelds yields the following advantages: 25-percent reduction in power requirements, 100-percent increase in electrode life, and reduced time weld cycle. To verify the integrity of the reduced quantity weld configuration, two alternate attachments were selected (Figures 2 and 3) and tested against the 8-weld baseline.

Procedure and Results

Three components (Figures 1 through 3) were fabricated from .016-inch thick, 2024-T3 clad material and tested per the general arrangement shown in Figure 4. Each component was compression loaded 15 times up to 300-pounds (limit load) then to ultimate failure. Ultimate failure results were as follows:

Configuration No.	Type	Ultimate Load, lbs.
#1	8-spot (baseline)	768
#2	6-spot, 1.375-in. spacing	778
#3	6-spot, 1.25-in. spacing	776

Metallographic examination of the configuration #2 diagonal brace attachment welds (MP-AMPD-MO-77-133) indicated that buckling failure did not have a detrimental effect on the integrity of the spotweld.

Conclusions

Based upon both the successful static compression tests and metallographic examination, the SFDS should use Configuration #2 for truss fabrication and realize the previously stated advantages.

WM:nk
cc
C. Micillo
A. Alberi
W. Bierds
J. Huber
W. Sisco
R. Witt

G 1160 REV. 6
3-76 250M

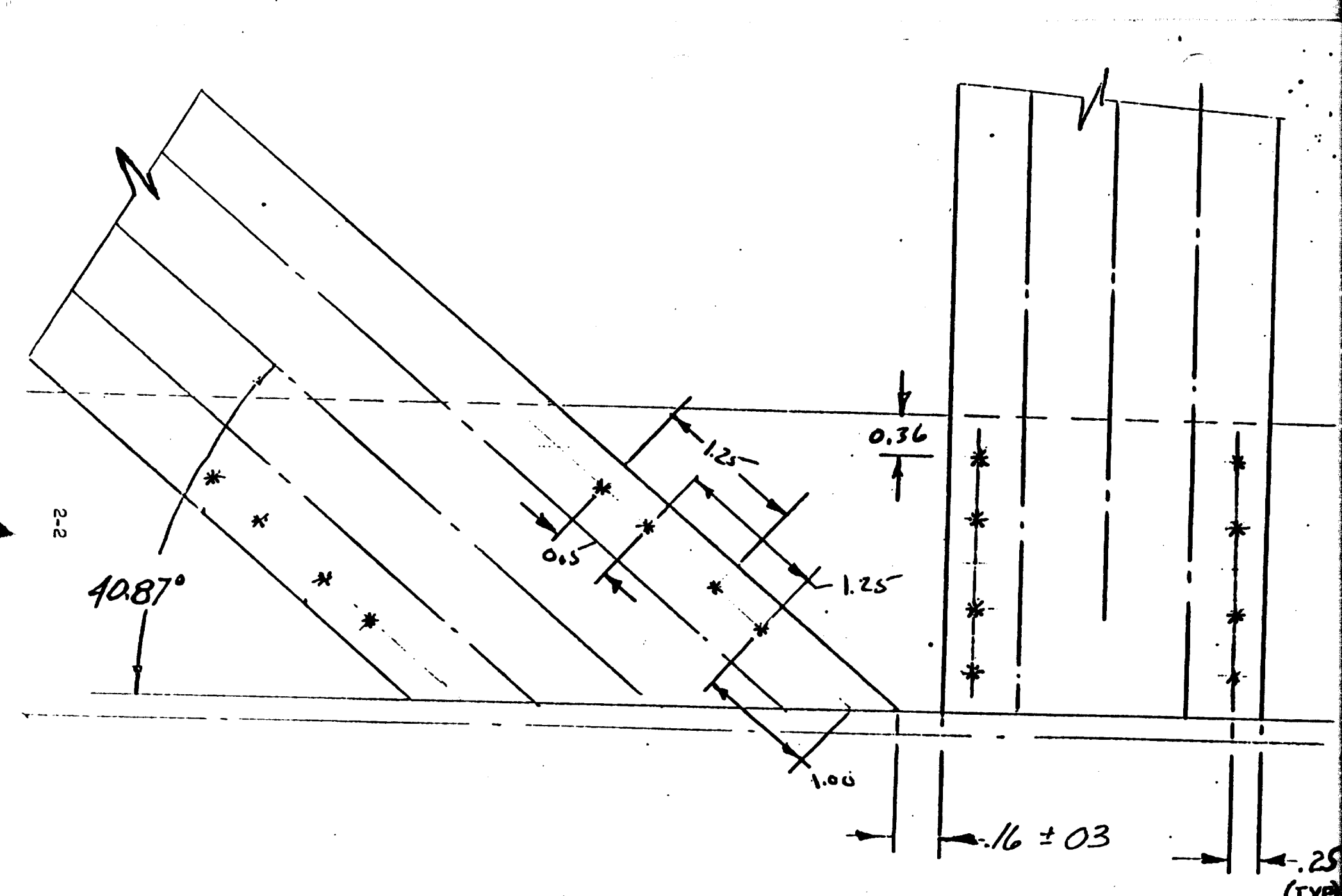

FIG. 1 SPOT WELD CONFIG. 1 & WELD / JUNCT

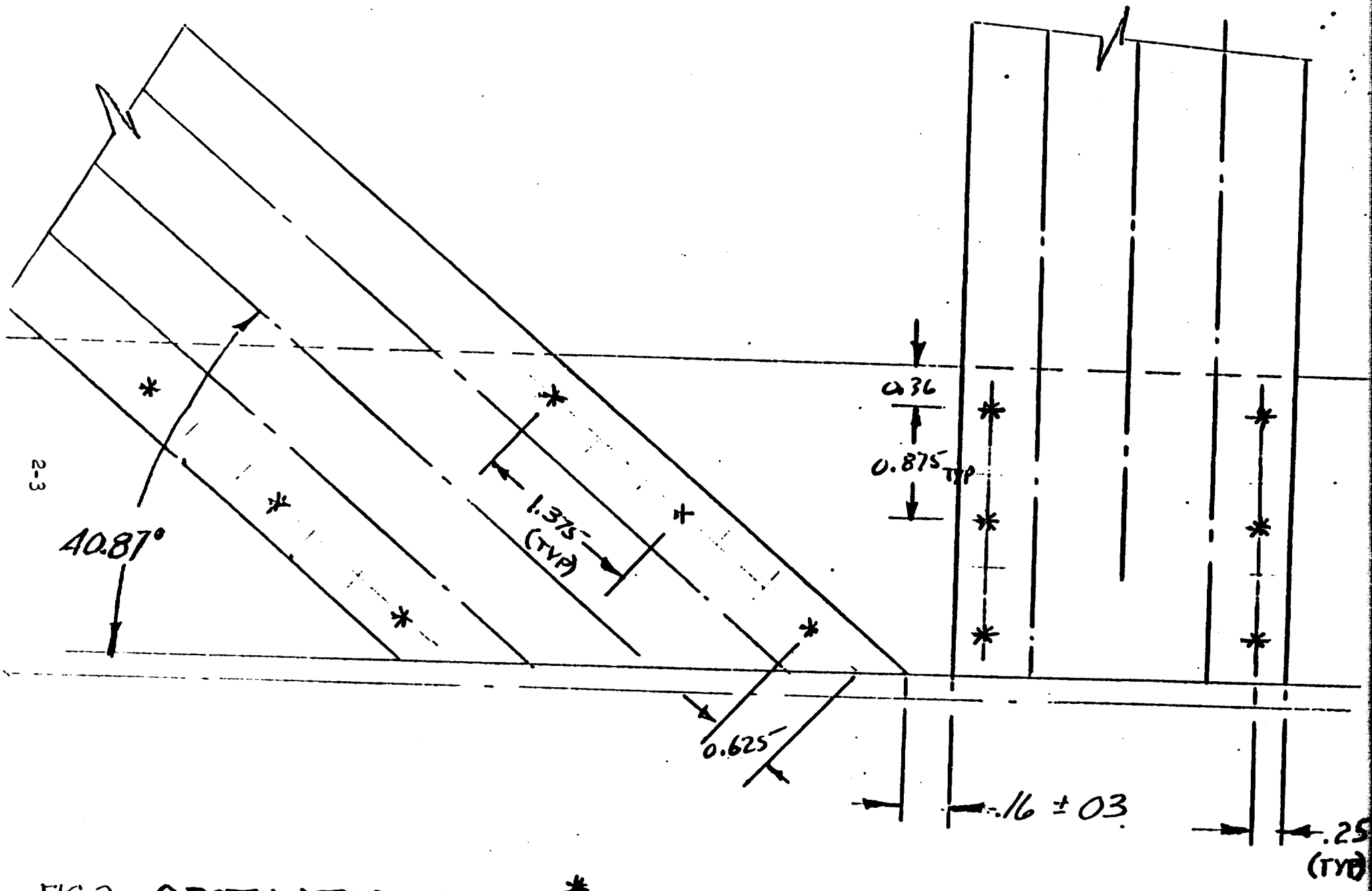

FIG 2 SPOT WELD CONFIG.2 6 WELD/JUNCT ~ MAX SPACING

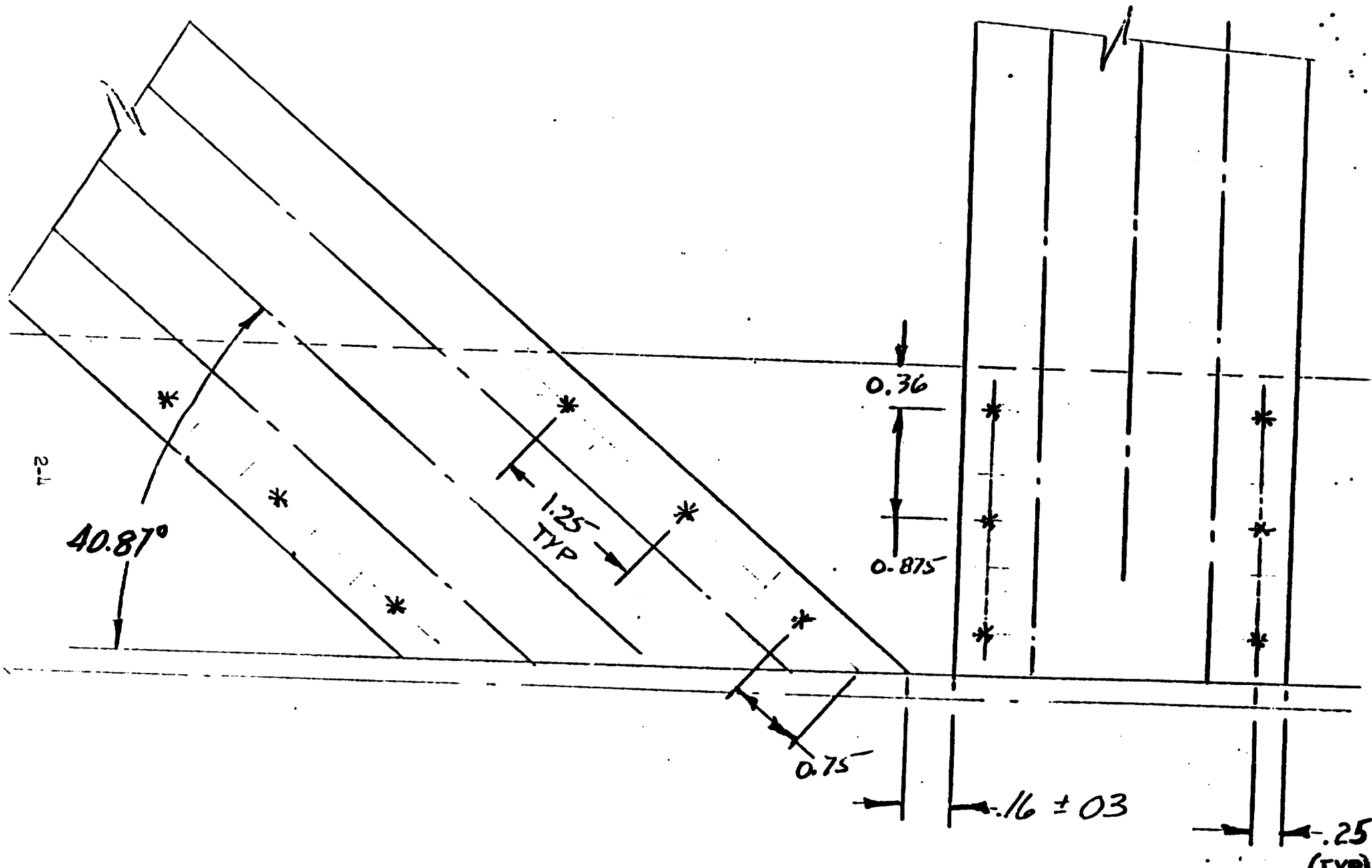

FIG 3 SPOT WELD CONFIG 3 C WELD/SUMET ~ MIN SPACING

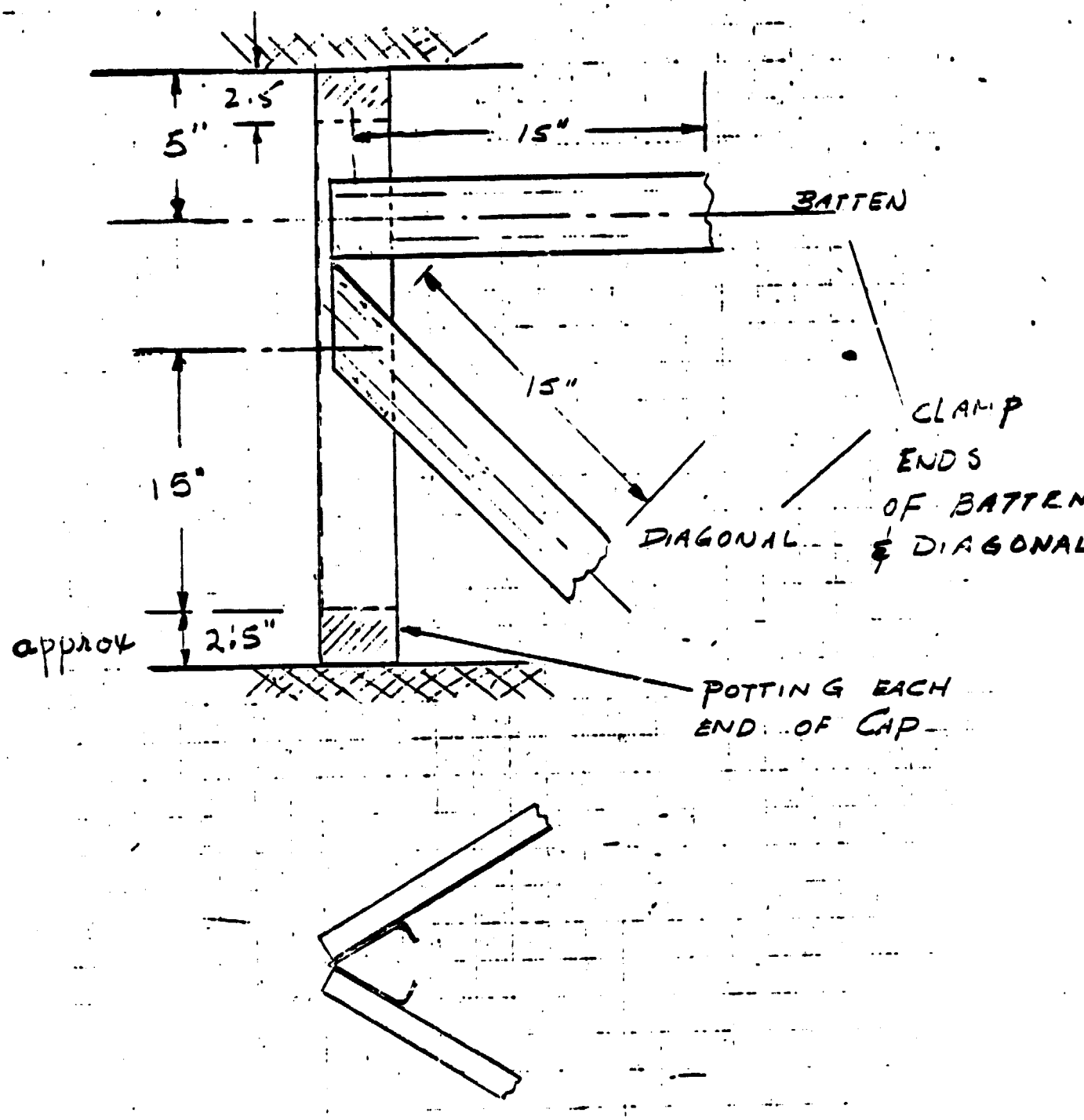

FIGURE 4 COMPONENT TEST ARRANGEMENT